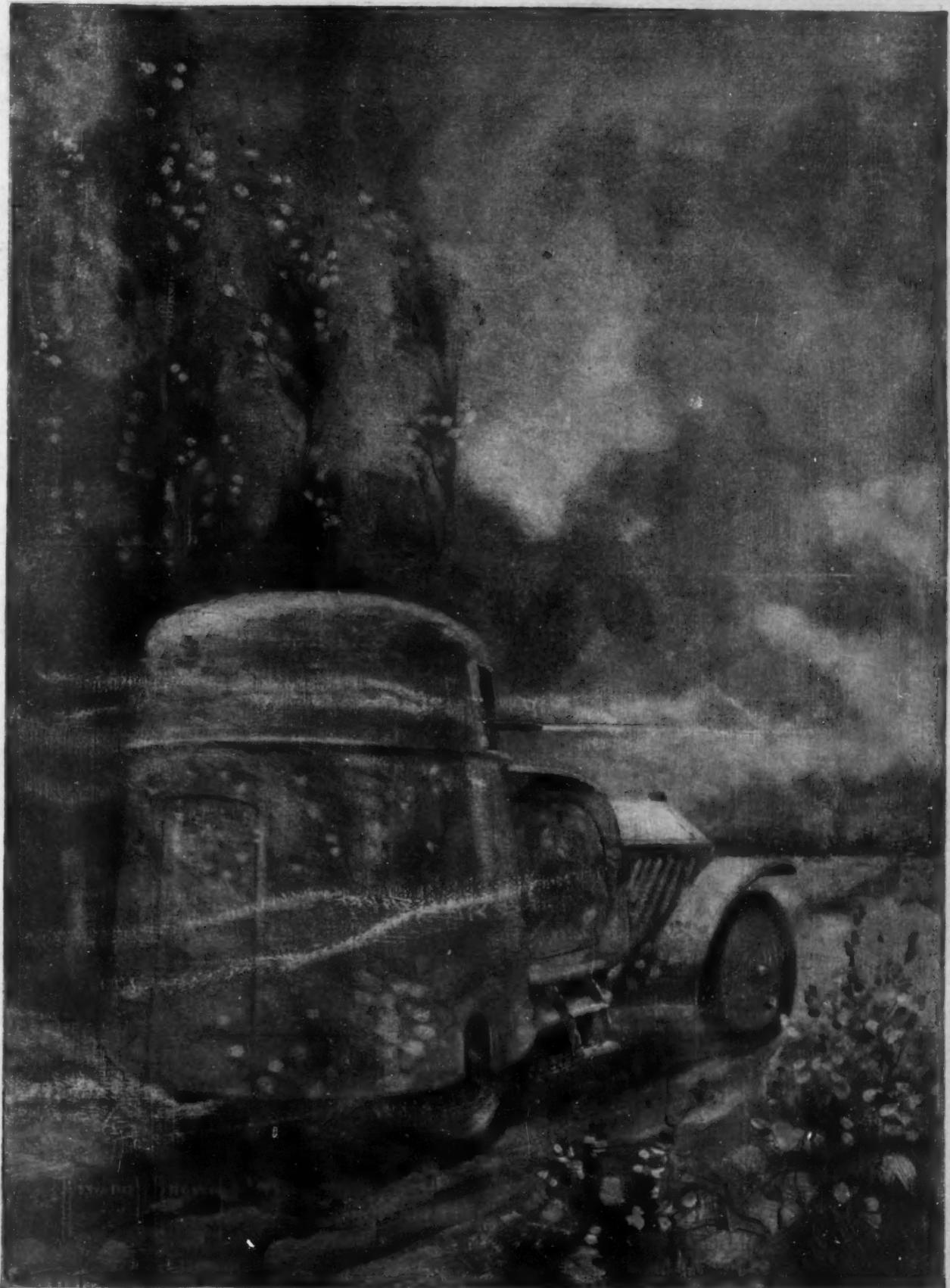


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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Technical Fallacies of the Present War

THE daily press is complaining of the severe censorship exercised over news from the seat of war; nevertheless, it would be better, in some respects, for the public if the censor's blue pencil were used even more freely than it is.

We refer to the sensational and misleading technical absurdities which from time to time are passed by the censor and permitted to go broadcast over the world for the confusion and bewilderment of the public, which is weary of rumors and asks only for the facts. If it is the duty of the censor to eliminate any statement which might be of value to the enemy, surely it is his duty, also, to cut out of the dispatches exaggerated statements as to the nature and destructive effect of the weapons which are employed by the combatants. If these exaggerations could have any beneficial effect, in misleading the enemy by causing him to modify his strategy or tactics, the censor would be following a precedent which has been employed from time immemorial in the conduct of war; but no such result is secured, and it is only the unsuspecting public that suffers.

The military censor knows perfectly well that all the statements which have been going the round of the press regarding mobile 16-inch guns used by the Germans, shrapnel which can annihilate a whole regiment with a single burst of one shell, high-explosive shells whose death-dealing gases kill a company of infantrymen without leaving a mark upon their bodies; he knows full well, we say, that most, if not all, of this talk is the veriest kind of rubbish.

That these absurdities are too often received at their face value is proved by the number of inquiries which come to this office, asking for further details respecting these appalling weapons of modern warfare.

In the first place, then, let it be understood that the 16-inch German mobile siege gun does not exist and probably never will exist. It is possible that some siege guns of this caliber have been built for fixed fortifications, but certainly never as mobile siege guns to be carried with an army in the field. The largest field siege gun is the huge 11-inch howitzer or mortar, which is shown in action on the front cover of the SCIENTIFIC AMERICAN of October 3rd, 1914, and is further illustrated and described on page 260 of that issue. It was a great feat on the part of the Krupp firm to produce a gun of this size, weight and power, that could be transported with an army over the highways of a hostile country, and go into action on its own mount, without preliminary foundation work, for the reduction of fortifications from five to seven miles distant. Broadly speaking, the weights both of a gun and its ammunition increase as the cube of the caliber. This means that a mobile 16-inch siege gun complete would weigh something over 100 tons, and its shell would be approximately one ton in weight. The finest macadam, brick, or concrete roadway would be crushed down under such a load, even supposing that traction engines of sufficient power and number could be linked up to transport it. It may have been done; but we doubt it.

Another fallacy is that of the wholesale annihilation of troops caused by bursting shrapnel. More than once we have been asked to explain what kind of a shell it is which, in bursting, discharges a shower of bullets "which will kill every man within a rectangle seventy yards square." The answer is that no such shell has

been invented, and never will be. On page 261 of our second War Issue, of October 3rd, the action of shrapnel is illustrated and explained in the article by Lieut.-Col. Leon S. Roudiez, adjutant general of the United States Army. The shrapnel shell contains 262 balls which, when the shell bursts in the proper position above the enemy's troops, will cover an area of ground elliptical in form. The area is, roughly, about 45,000 square feet. Now anyone can calculate for himself that, if the dispersion is fairly even, there will be an average of one ball to each 120 square feet of space covered, or say, one ball to each square measuring about eleven feet on a side. If the troops under fire are in a trench, with only head and shoulders exposed, and with, say, three feet interval between the men, it will be seen that the chances of a bullet finding its man are one in one hundred for each bursting shell.

Even more ridiculous are the stories about the killing of groups of men by the shock and the poisonous gases of exploding shells. More than once, in describing the trenches or city streets after a battle, or houses that had been under shell-fire, correspondents have spoken of the dead being found without a single scratch upon their bodies and preserving exactly the attitude in which they stood or sat, when this mysterious engine of destruction smote them. The shock of exploding shell may produce deafness and temporary unconsciousness; but if the explosions take place near enough to produce death, the men affected will be hurled by the blast in every direction.

Then there is the subject of bomb-dropping from aeroplanes and dirigibles, regarding whose military value as a means of reducing fortifications or even of destroying cities there is in the public mind a greatly exaggerated estimate.

We do not hesitate to say that one of the German 11-inch siege guns, aided by range-finders and observers at the end of a measured base line, would place more shells within a fort in a single hour than the whole fleet of German dirigibles could do in an all-day attack.

The Problem of Our Merchant Marine

AN American-built merchant steamer costs more per ton to construct and equip than a ship of the same size and class built in the yards of our foreign competitors; furthermore, when the ship goes into service, the cost of American operation is greatly in excess of the cost of operation in the foreign merchant service. Burdened with these disadvantages, the American deep-sea carrying trade has not proved attractive to American capital, and the tonnage of American deep-sea shipping has dwindled to an insignificant amount.

With a view to removing the first disability, that of high first cost, Congress has recently passed a law which makes possible the purchase of foreign-built ships for operation under the American flag; but, unfortunately for the solution of the problem, the greater first cost of an American-built ship is not nearly so serious a handicap as the very much greater cost of her operation. Hence, although under the new law thirty-six foreign-built vessels of 135,895 gross tons have already been registered for foreign commerce, it is realized by all who have made an intelligent study of the problem, that something more remains to be done, if we are to enter the deep-sea trade with any hope of obtaining a merchant marine of a size commensurate with our wealth and commercial standing.

We commend to the serious study of the public a series of three articles on our merchant marine which have been contributed to our columns by Winthrop L. Marvin, the last of which appears in the present issue. The question of how to restore our merchant marine to its former position of supremacy is many-sided and difficult, and the issue is greatly complicated by the fact that in Congress it has been clouded by political considerations and the tendency of Congressmen to regard the subject from a local rather than from a broad national point of view. Mr. Marvin's study of the question is clear, forceful, and very convincing.

In the first of his articles, published in our issue of October 3rd, Mr. Marvin reviewed the history of our merchant marine, and showed that although there were several contributory influences tending to bring about its decline, the fundamental cause was the passing by Congress in 1828 of the so-called reciprocity act which opened the carrying trades from other countries to the ships of Great Britain and our other European competitors. The proportion of American commerce conveyed in American ships began almost immediately to decrease, and it has been falling ever since, until to-day it has all but reached the point of extinction.

It is pointed out in the current article by Mr. Marvin, that the majority of the thirty-six ships which have been brought under the American flag by the passage of the act on August 18th, 1914, were foreign-built vessels which were already registered for foreign commerce, and that the foreign officers of some of the naturalized vessels have promptly claimed and received

the wage rate of American officers. Thus the pay of the British engine room force of one steamer of the United States Steel Corporation was thereby increased from \$282 to \$420 a month. That the probable failure of the free registry law to fully meet the needs of the case is recognized in Congress is shown by the fact that a bill which receives strong Government support is up in Congress, for Government control and operation of steamship companies in which private investors shall be allowed to have a minority interest. This, however, we cannot but regard as an expedient of very doubtful value.

Mr. Marvin concludes that the maritime conditions now confronting the American people are strikingly like those which faced Washington, Jefferson, and Madison in 1789. They met the crisis in a series of enactments which gave preference in employment to American ships in the carrying of American commerce. Of the two ways (rebates or subsidies) of renewing these conditions, one or the other would seem to be absolutely necessary; this for the reason that our foreign competitors are so largely subsidized. We are of the opinion that the more preferable would be the adoption of a system of preferential duties, under which there would be a percentage rebate of custom duties upon all freight brought to ports of the United States in American bottoms.

There is every reason to believe that a nationally protected merchant marine would to-day exhibit a growth in numbers and tonnage commensurate with that which it enjoyed in the early days of the country.

A Dearth of Foreign Scientific Journals

WHILE the precise effects of the present European conflict upon America's supply of meats, groceries, and the like has been a matter of such uncertainty as to call for Government investigation, the abrupt curtailment of mental pabulum in the shape of scientific literature from the countries engaged in the struggle has been only too evident. The librarian of a large scientific library informs us that not a scrap of literature of a date later than August 1st has come to hand from Germany, and only a solitary scientific journal, viz., the *Oesterreichische Flug-Zeitung* of August 10th, from Austria. The Austrian publication opens with the announcement that many of its staff have been called to the colors, and craves the indulgence of its readers for the results of this untoward situation upon the contents of the journal and for possible future delays in publication. Several French scientific periodicals have continued to arrive with little or no delay; others, including the well-known popular weekly *La Nature*, have been definitely suspended until the war is over. The *Comptes Rendus* of the French Academy of Sciences has, in accordance with its official character, been strongly colored with expressions of patriotism since the war began. The number corresponding to the session of August 3rd contains a declaration by the president of the Academy that all academicians not already mobilized in the public service hold themselves ready to aid the national defense according to their several specialties. The number of August 10th pays tribute to the Belgian nation and army, and contains a memoir addressed to French military surgeons giving practical advice as to the treatment of wounds. The English journals are still arriving regularly.

The Agricultural Advisers of the French Government

THE recent reorganization of the Superior Council of Agriculture (*Conseil supérieur de l'Agriculture*) of the French government calls attention to an interesting official body having no equivalent in the government of the United States. Established in 1882, it was reorganized by a decree of March 4th, 1893, and again by a decree of July 15th, 1913.

It is the duty of this council to give advice on all questions proposed by the Ministry of Agriculture, particularly in connection with agricultural legislation, measures for the encouragement of agricultural production, questions of agricultural sociology, political economy, duties and tariffs. In its new form the council includes three classes of members; namely, *ex officio* members, elected members, and members nominated by ministerial decree. The *ex officio* members comprise the president of the agricultural committees of the Senate and the Chamber of Deputies, and the chiefs of the various divisions of the Ministry of Agriculture. The French Academy of Sciences and the agricultural associations are each represented by one elected member, as are also the twelve external services connected with the Ministry of Agriculture. Lastly, the Minister of Agriculture nominates 60 members, chosen for their distinguished work in pure or applied agricultural science, and 25 members distinguished in economic and social matters. All members are chosen for three years, and are re-eligible indefinitely.

Engineering

The Taxi Competes with the Rickshaw.—Engineering has even invaded the field of the rickshaw coolie in Ceylon. A taxicab service with 20 automobiles of American make is to be put into immediate operation in Colombo. The fares are made low with the idea of successfully competing with the rickshaw.

Italian Navy Seeks American Steel.—A report from Rome states that owing to all steel material for ships under construction for the Italian Navy being tied up in France and Germany, the United States is looked to for the needed material, and American steel plants have been approached with a view of securing the large tonnage required.

Economy of Oil-fired Locomotives.—Trials of Argentine petroleum in one of the locomotives of the Port of Buenos Aires in the last two months have so well satisfied the authorities that it has been decided to use it in all the locomotives of the port. The test was made with Comodoro Rivadavia petroleum in a 250 h.p. locomotive which it showed economy over coal of 20 to 30 per cent.

Fluorspar Production.—Fluorspar production in the United States in 1913 aggregated 115,580 tons, the average price being \$6.37. Imports were 22,682 tons which averaged \$3.15 in price. About 80 per cent. of the domestic and all of the imported was consumed as a flux in basic open-hearth steel furnaces. The small remainder was used as a flux by silver, copper, and lead smelters; in the manufacture of fluorides of iron and manganese for steel fluxing; in the manufacture of glass and enamelled ware; in the production of aluminum; electrolytic refining of antimony and lead, etc.

Important Railroad Construction in the Caucasus.—A concession has been granted to a Russian Prince and associates for the construction of a railroad in the Caucasus to connect the celebrated resort, Borjum, with Kars, which will be 233 miles long and cost approximately \$32,000,000. Application has also been made for permission to form a company to build another road 129 miles long to cost about \$7,000,000 which will extend from Atlat, on the trans-Caucasian Railroad, to Astara and complete a chain of railroads connecting northern Persia with the industrial cities of central Russia.

American Mining in Korea.—Nearly all the important gold mines of Chosen are concessions given to foreigners by the former Korean Government. Most of these are in the hands of Americans. Prior to the annexation in 1912 the annual output of precious metals was about \$2,500,000. It is now valued at about \$4,500,000. The most prosperous mines are at Unsan. They are managed by an American Company and employ about 70 officials and 2,000 miners and laborers. There are also deposits of anthracite, iron, graphite and copper but the major portion of present results come from the gold mines.

Harbor Improvements for Formosa.—One of the most important public works now being carried on by the Taiwan Government is the improvement of the harbor at its principal port, Keelung, at the extreme northern end of the island, through which passes more than half of the shipping. The new work includes large warehouses of steel and of reinforced concrete; a sea wall, for protection against the destructive typhoons, is to be lengthened some 14,000 feet; twenty-one mooring buoys are to be placed; and eight cranes of 1½ and 10 tons are to be added to the equipment. Improvements of the same general nature are also being carried on at Takao, Tansing and Tansui.

Blasting with Liquid Oxygen.—It has long been known that liquid oxygen mixed with substances like cotton wool forms a powerful explosive, but serious difficulties were encountered in its practical use. A new method has now been discovered for handling this oxygen that makes it practical for commercial use. Bags are filled with a special form of lamp black, which are soaked in the liquid oxygen for a few minutes just before they are required for use. If the bag is now lighted with a match it will burn quietly and very slowly, but if detonated it explodes with the force of dynamite, and the cost is much less. Much less carbon monoxide is given off than by most other explosives, and there is no danger from a misfire as the oxygen will evaporate in a short time.

A Hundred Foot Standard for Chicago.—The Western Society of Engineers has had prepared a 100 foot length standard which it has presented to the city of Chicago. This standard is a steel rod 102 feet long, two inches wide and half an inch in thickness, which rests on rollers secured to substantial brackets fixed to the wall. The graduations, which were established by Prof. L. A. Fischer of the U. S. Bureau of Standards, Washington, D. C., were at zero, 1 foot, 1 yard, 1 meter 10 feet, 25 feet, 50 feet, 66 feet, 20 meters, 30 meters and 100 feet, and at each of these points a disc of an alloy of 90 per cent platinum and 10 per cent iridium 5.16 inch in diameter was inserted in the rod flush with its surface, the exact division point being marked on the disc. The work of graduation proved remarkably accurate, as is shown by the correction table furnished for use in connection with comparisons of measures.

Science

The Effect of the War on Our Universities.—An interesting criterion on the effect of the European war on our universities is afforded in a statement given out recently from the Chemistry Department at Columbia University. According to that department, a list of students who prior to the war had planned to go to Germany to study are now seeking information as to the courses afforded at home, and it is estimated that when the university opens, the registration at Columbia in all of its departments will be materially increased through the students who cannot pursue their studies abroad. One of the courses which is especially attracting those who had contemplated a winter at the German institutions is that afforded in Industrial Chemistry. The reason for this furnishes another illustration of how much Germany is sacrificing, educationally as well as economically, in the present war. She stood foremost in the production of chemical industries, and her universities offered courses in industrial chemistry which were the model of the world.

Isomorphism.—The phenomenon of isomorphism, or identity of crystal form, is very interesting and at the same time easily demonstrated by simple experiments. For instance, when a crystal of chrome alum is suspended in a saturated solution of potassium alum, we get a crystal having a violet center and a clear white overgrowth. This experiment may be repeated using any of the alums or vitriols having the same relative composition. A few examples of isomorphous substances are given below which were chosen on account of their colors:

Nickel sulfate.....	green
Magnesium sulfate.....	white
Potassium sulfate.....	yellow
Potassium chromate.....	white
Ferrous sulfate.....	green
Magnesium {	white
Zinc	

Isomorphism has found a practical use through its aid in the determination of the atomic weights, for, as will be noticed, isomorphous substances always have the same number of atoms to the molecule. Thus the formulae for nickel sulfate and magnesium sulfate are $MgSO_4$ and $NiSO_4$, respectively, each having six atoms to the molecule.

The Australasian Antarctic Expedition, 1911-1914.—*The Geographical Journal* for September contains the first comprehensive and connected account of this remarkably fruitful expedition that has yet appeared in print; viz., the full text of the lecture delivered by Sir Douglas Mawson before the Royal Geographical Society, June 9th, 1914. It is accompanied by excellent photographs and charts. The lecture clears up two points that have been obscure and mysterious in the previous news of the expedition: (1) The name "King George V. Land" has been given by Mawson, not to the whole coast explored by his expedition (the "Wilkes Land" of most geographers), as shown on the chart published in *Nature* of March 5th, 1914, but to a relatively small region at the eastern end of this coast and just east of Adelie Land. (2) The curiously bungled dispatch published in American newspapers in August, 1913, according to which a New Zealand government steamer had relieved Mawson and his marooned companions in the dead of the Antarctic winter, and had found them on the verge of starvation, really referred to a journey made by the steamer "Tutanekai" to Macquarie Island, to carry aid to the small section of Mawson's expedition left there to maintain a wireless station. Mawson himself was in Adelie Land at the time, and of course inaccessible.

Publications of the Bureau of Standards.—The U. S. Bureau of Standards published last year, as Circular No. 24, a list and detailed analysis of the scientific, technological and miscellaneous reports, papers, etc., issued since its work began in 1901, the total number amounting to about 300. A supplement has recently been published, bringing the list down to date. Most of the scientific papers issued by the Bureau are published originally in its Bulletin, which is now in its tenth volume, and are then reissued separately. The complete Bulletin is furnished free to educational and scientific institutions, while the reprints of separate papers are furnished free to individual applicants. There is a separate series of technologic papers, begun in 1911, and a series of Bureau circulars. The whole literary output testifies to the remarkably varied and extensive researches which have been carried on by this official institution in connection with the task of establishing and maintaining the various standards and units of measurement, the development of measuring instruments and methods, and the determination of physical constants and the properties of materials. The Bureau is constantly making important contributions to the world's knowledge of electricity, photometry, heat, optics, chemistry, etc., and probably approaches more nearly the ideal of a research institution than any establishment of the United States Government.

Automobile

A New Starter for Explosive Engines.—D. Maurice Hartsough, of Minneapolis, Minn., in a patent, No. 1,105,775, utilizes in explosive engines for starting purposes a portion of the gas compressed in one or more of the engine cylinders, stores the gas in a reservoir, and introduces it into the engine cylinder or cylinders to start the engine.

One Result of Standardization.—The results which follow the introduction of standardization of automobile parts, and, above all, a standardization of their method of manufacture, may not always be as readily appreciable as in the case with one Syracuse manufacturer who has been able to reduce the manufacturing cost per car by as much as \$600. The Taylor system of scientific works management was begun in 1908, but not perfected until four years later.

Increasing Mileage of Electrics.—The recent performance of an electric automobile is interesting, and calls to mind the days of not so long ago when to obtain as much as 100 miles on a single battery charge was considered quite out of the ordinary. The car to which we refer was owned and driven by a private owner. He drove from Philadelphia to Atlantic City and return without having his battery either charged or boosted on the journey. The distance by road is 130 miles and the car averaged 15 miles an hour. The battery used was a regular stock battery of the lead-acid type.

Room for Magneto Simplification.—Although the modern automobile has been marvelously simplified in the past few years, comparatively little attention has been paid to the ignition system. True, the present high tension magneto and jump spark are infinitely simpler—at least in operation—than the older low tension system, with its eternally leaking make and break mechanism. But still there appears room for simplification of the high tension magneto. Why cannot the make and break parts for instance be made lighter and perhaps of a type so that the hammering of the parts due to their weight will be decreased?

Steel Cylinders Economically Made.—Although the use of steel cylinders is fairly common in aeronautical work, this construction has not yet become very common for motorcars, due probably to the high cost. Latterly, however, a Berlin firm has succeeded in producing steel cylinder motors which cost but little more than the old cast iron type. The principal advantages of the steel cylinders are: First, their light weight which is one-third lighter than the lightest cast iron cylinder; second, their clean appearance; third, the possibility of better cooling due to the thin metal; fourth, increased thermal efficiency because higher compression is possible with better cooling; fifth, accuracy of manufacture.

New Primary Battery Cell.—A new primary battery cell, the invention of Dr. E. Bellini, which gives promise has made its appearance on the foreign market. Plates of lead amalgam, obtained by pouring 10 grammes of mercury into 90 grammes of molten lead, form the negative elements. The positive element is carbon, and the two are immersed in a solution of 80 parts sulphuric acid, 120 parts of nitric acid and 1,000 parts distilled water. One battery consisting of four positive plates and three negatives, the plate surface being 900 square centimeters, had an internal resistance of 0.022 ohms at 5 amperes discharge. The capacity was 112.5 ampere hours, after which the electrolyte required additions of acid.

Palpable Piston Ring Fault.—The almost universally used eccentric, split piston ring does not give the satisfaction that is expected of devices of the kind by modern automobile engineers, and it is interesting to note that latterly rings of other types are coming in for a greater share of attention than heretofore. The concentric ring, which a few years ago was practically unheard of, is now used quite extensively, and there are several other types of rings built in sections that now are becoming popular. The most prominent trend at present is toward the use of a number of concentric rings, say three or four, very thin and made of steel, in each piston ring groove. With these it is unlikely that the splits will line up and so permit the gases to escape, and there is less likelihood of the gases passing behind the rings.

Wanted—A Gasoline Separator.—Now that the Mayor of the city of New York has placed his veto upon the measure which would have repealed the ordinance making compulsory the equipment of public garages with what have come to be known as oil separators, attention naturally will center upon these devices if for no other reason than because the garagemen have so consistently fought against them upon the grounds that they will not prevent gasoline and oil from entering the sewers, which is their purpose. Notwithstanding numerous sewer explosions it is claimed that the quantity of gasoline that finds its way into the sewers is so small that the separators of which there are several types, will not serve their purpose. If this is so, it would seem that there is ample room for the exercise of genius in the evolution of a device which really will separate the oil and gasoline from the water and hold it.

Letters from the Firing Line

By an Officer in the French Army. Special War Correspondent of the Scientific American

I HAVE spent a part of the night going over my war diary, and have picked out the facts which, I thought, would interest you most. Do excuse the careless way in which I write; *à la guerre comme à la guerre*. It is night. My table is a drum and my lamp a wax candle, which blows out with each gust of wind. We expect at any moment to hear the call to arms, for the enemy is looking for a chance to surprise us. He will not find us asleep!

When you receive this letter the engagements which have taken place from the Belgian frontier, extending almost to the walls of Paris, will perhaps be already forgotten. Other engagements of no less importance are now going on at different points of the line.

You probably have learned, through the newspapers, that the battles fought on Belgian territory have been of the fiercest kind. It is also superfluous to tell you that the "*tenue au feu*" (behavior under fire) of our infantry is above all praise, and that the efficiency of the French artillery has proved to be superior to that of the enemy, notwithstanding the heavier weight and greater number of the German pieces of artillery. I will not give you in any detail my impressions on the field. Frankly, it is rather disagreeable to hear the shriek of the shells overhead, to say nothing of the prolonged and deafening roar of your own and the enemy's artillery. However, before having experienced it, I thought it would be harder to stand than I really found it. At first, this terrific din and concussion of the artillery duel produced severe headaches.

Heartbreaking, and far more tragical to see than the fight itself, is the aimless flight of the terrorized population before the invader.

Each day our heart hardens a little more. It is as well that it should, for the soldier who is called under fire. Neither good nor bad news affects our nerves. Offensive, defensive, charge, retreat, victory; the words have lost their heart-stirring, their emotional effect, and we obey orders almost automatically. A blind force seems to drive us. We do not want to see—we close our eyes when along the highway comes rumbling a train loaded with wounded soldiers. We do not want to think; and if on the list of the dead we see or hear the name of a comrade, of a friend, of a chief fallen on the field, we try to forget.

Our lines are crossed incessantly by villagers in tears—men, women, and children—some on wagons, some on foot carrying their belongings in a bundle tied at the end of a stick. Most of the time they do not know where they are going; they simply go, hoping to find, somewhere, a refuge. A few days ago we stopped in a deserted village to rest after a long march, and we found on a farm an unfortunate woman alone. She was lying on a litter of straw, and clasped in her arms a child to whom she had just given birth.

One of the most appalling sights, to which even the most hardened among us cannot remain insensible, is that of the starving children who surround us at meal time. They beg for food; like famished dogs they pick up from the ground the crusts we cast away, and no one can stand the look of hunger on their pale little faces.

The service of the field kitchen is well organized. Our "*boules de son*" (wholewheat bread), nicely browned by expert cooks, are served us with the most precise exactitude. There is not a squadron or a regiment which cannot boast of a cook who knows at least six different ways of serving a piece of beef. When we depart for the field, our knapsacks are heavy with all the entrees which have been distributed to the men. But if the soldiers have plenty of food supply, the poor villager has nothing to eat. Yesterday two little girls said before me: "We have not eaten for two days; there is not a crumb of bread at home." Each day the number of people who come to beg for what is left of the soldiers' soup and bread is greater and greater.

The other evening Charleroy was in flames! I watched the colossal holocaust, and it called to mind that tragical hour of the Roman Empire, the burning of Rome.

If the unfortunate villagers and those of our wounded who had been spared in the slaughter had not told us of the cruelty of our foes, it was enough to see the sinister conflagrations of the towns and villages, to understand that neither the Vandals nor the Huns would have shown such a useless ferocity in their devastations.

I cannot remember without a pang the sorrow of that priest, a tall, old man with white hair, who was crying at my side, while the incendiary flames were devouring the town. "I do not see," he told me, "why

God imposes life upon me. I cannot close my eyes without seeing corpses, ruins, and blood everywhere. I want to be among my flock in the cemetery. My body is here, but my soul is with the dead, the many innocent victims whom I mourn."

I witnessed a few days ago an interesting scene. After a short encounter, our troops succeeded in repulsing the enemy, who evacuated the village. No sooner had the invader left than all the inhabitants reappeared and hurried toward the fields to harvest the crops. They worked silently, peacefully, driving the horses, who avoided the dead bodies lying in the wheat.

As soon as the battle of Haelen was fought the same laborers cut and housed their crops; afterward they returned again to their fields and dug graves, where they buried, after counting them, thousands of dead.

Our women, the girl in her teens as well as the white-haired grandmother, take the place of the missing men, and work from dawn to night to harvest the crops. They do all that is humanly possible to help the nation.

To check the invader is for us a matter of life or death. It is impossible to say on which side the toll of death is the greatest. In the region where I am, the north end of France, which is known as one of the most fertile of the country, the apple trees shelter the dead by the hundreds. Everywhere one sees corpses and from the woods comes an insufferable odor.

After three days and three nights of fighting along the River Sambre, we succeeded, in the dark of the night, in surprising the enemy, and inflicted severe losses. The number of the dead lying along the canal of the Sambre was so colossal that we were obliged to take another road. Yesterday I was in the hospital, when two wagons drawn by oxen brought their cargo of wounded. In the first cart were three Germans, and in the second two Frenchmen and two Germans. The nurses, prompted by their patriotism, rushed to the second cart, desiring to attend first to the French soldiers, but the army surgeon stopped them and said: "Bring the wounded in the order they arrive." And without taking notice of the nationality, he and his assistants began their humanitarian task.

A young soldier, a Turco, hardly twenty years old, was brought into the hospital. His arm and thigh were badly torn; but he refused stubbornly to let go his gun. "What do you think," the army surgeon said to me, "this boy won't part with his bayonet; and we had a devil of a time to dress his wounds. He threatened to tear the bandage off, if we took his gun away. He is a brave—three bullets in his right arm, his side in a mess, and the femur bone broken by a shrapnel." At night the young Turco lays his gun by his bed, and in the morning his first inquiry is for it.

Our offensive has not succeeded yet in holding back the enormous army of the enemy. We were forced to take again our positions of defensive, which are yet intact. The impetus of the German army is terrific. They realize that their only chance is in a quick action. Feeling already the Russians at their heels, they throw themselves furiously on France in their mad desire to be done with us in time to turn upon their Russian foe.

Their only thought is to advance, no matter how heavy the cost of lives. With an unflinching will and a cold frenzy, the great chiefs of the German army sacrifice every day, in the face of our cannons, thousands of their best soldiers. It would look as though they had taken an oath to smother us under the avalanche of their corpses.

The German army possesses more machine guns than the French, and in their haste to vanquish us by their fire, and turn their forces on the Russians, they are lavish of the lives of their soldiers.

In rifle fire the two armies are equivalent; but our artillery is far superior to theirs, and also our bayonet and sword.

We are still retreating toward Paris. We will reach there to-morrow at the latest. All along the roads the bodies of the unburied soldiers are mixed with the carcasses of the horses. Among the former I recognized some faces. One had been my chum at college. I had loved that tall boy whose body lay across the road.

Yes, we are retreating on Paris, and as we near the French capital, the determination to win, to vanquish the enemy, no matter what the cost, grows stronger within us!

The Current Supplement

THE front page of the current SCIENTIFIC AMERICAN SUPPLEMENT, No. 2024, for October 17th, shows the first big ship built in England that is powered with a Diesel oil motor, and besides the view of the engine room there are other illustrations of the mechanical

equipment. Projectile Photography tells how to make pictures of bullets in full flight with simple apparatus. The interesting article on the Germplasm is concluded. There is a timely article, with excellent illustrations, describing a portable hangar for housing big airships in the field. The proper lighting of courts to enable visual evidence by modern methods to be presented brings up a matter of great importance that has heretofore been almost inexcusably neglected. There is an interesting article on explosives, by an English authority; the influence of forests on climate is explained and shown by many references by an Australian expert. Theories on the movement of the moon are reviewed and compared with observations in an article that calls attention to the desirability of further work on lunar problems. Other articles tell of experiments to prevent fog; first aid to the wounded; the last wild pigeon; and various other informative matter.

Ships Destroyed by the War

A MARINE insurance firm in Amsterdam has issued a list of vessels that have been lost as a result of the war, which includes a number that have not heretofore been reported. This list is believed to cover all that have been lost up to September 10th.

The following British steamers were lost, as described:

"Craigforth," 2,900 tons, struck mine near Constantinople and sank; "San Wilfredo," 6,458 tons, struck mine near Wilhelmshaven August 16th and sank; "Hyades," 3,352 tons, sunk by German cruiser on August 16th, near Pernambuco; "Kaipara," 7,392 tons, sunk by "Kaiser Wilhelm der Grosse"; "Nyanga," 3,066 tons, ditto; "Holmswood," 4,223 tons, sunk by German cruiser "Dresden"; "Bowes Castle," 4,650 tons, sunk by German cruiser "Karlsruhe"; "Barley Rig" (drifter), struck mine in North Sea and sank; "Thomas W. Irwin" (trawler), ditto; "Crathie" (trawler), ditto; "Tubal Cain" (trawler), 227 tons, ditto; "Seti" (trawler), sunk by Germans; "Ajax" (trawler), struck mine in North Sea and sank; "Eyre" (steam drifter), ditto; "Lindsell" (steam drifter), ditto; "Runo," 1,679 tons, ditto; "Valiant" (trawler), sunk by Germans; "Viry" (trawler), ditto; "Imperialist" (trawler), struck mine and sank; "Revigo" (trawler), ditto.

The following British vessels were also sunk by the Germans: "Argonaut," "Capricornus," "Lobelia," "Harrer," "Chameleon," "Pegasus," "Pollux," "Fideo," "Rhine."

Vessels belonging to other countries are as follows:

Steamer "Alcos," 3,233 tons (Dutch), sunk by Russians; steamer "Alice H." 3,052 tons (Dutch), struck mine and sank near Dago; steamer "Tysla," 4,676 tons (Norwegian), struck mine and sank near Wielingen; steamer "Gottfried," 426 tons (Norwegian), struck mines in North Sea and sank; steamer "Baron Gautsch," 2,069 tons (Austrian), struck mine near coast of Dalmatia and sank; steamer "Bathori," 2,223 tons (Austrian), near Spanish coast sunk by H. M. S. "Minerva"; steamer "Carl," 3,336 tons (German), sunk by Russians in harbor of Onega; steamer "Erika Fischer," 1,300 tons (German), ditto; steamer "Karl Fried Larsen," 1,500 tons (German), ditto; steamer "Königin Laise," 2,163 tons (German), sunk by British warships; steamer "Kaiser Wilhelm der Grosse," 13,952 tons (German), ditto; steamer "Albertine," trawler (German), ditto, sunk September 15th; steamer "Christian Broberg," 1,225 tons (Danish), struck mine August 21st and sank; steamer "Maryland," 5,136 tons (German), ditto; steamer "Skull Fogeti" (Danish trawler), 272 tons, struck mine August 27th and sank; steamer "Gaen" (sailing vessel), 235 tons (Danish), ditto; steamer "Karma," 1,270 tons (Danish), ditto; steamer "Express," 717 tons (Russian), struck mine near Otschakoff August 11th and sank in 10 minutes (54 persons lost); steamer "St. Paul," 2,534 tons (Swedish), struck mine in North Sea September 2nd and sank.

London Traffic

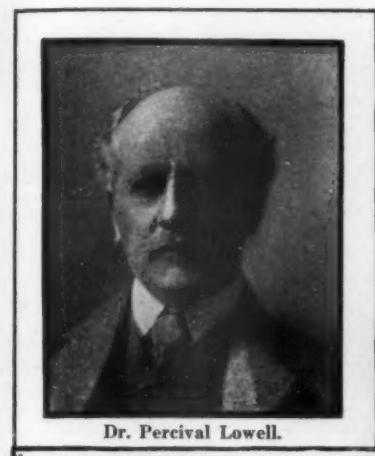
THE English Board of Trade has published an interesting statistical account of traffic in London. While the number of inhabitants in London has increased from 6,710,272 in 1903 to 8,471,146, the number of journeys per head per year has increased from 145 to 244. The number of passengers on electric tramways was 763,797,856 in 1910, 821,819,714 in 1911, and in 1912 descended to 797,487,581. The number of people transported by motor-bus has continually increased. It was 377,207,550 in 1910, 406,628,487 in 1911, and 551,622,398 in 1912. Owing to the protective devices employed, the number of accidents due to electric tramways is very small. Out of 100 fatal accidents, only 1½ are due to the electric tramways.

Our Knowledge of the Planet Mars

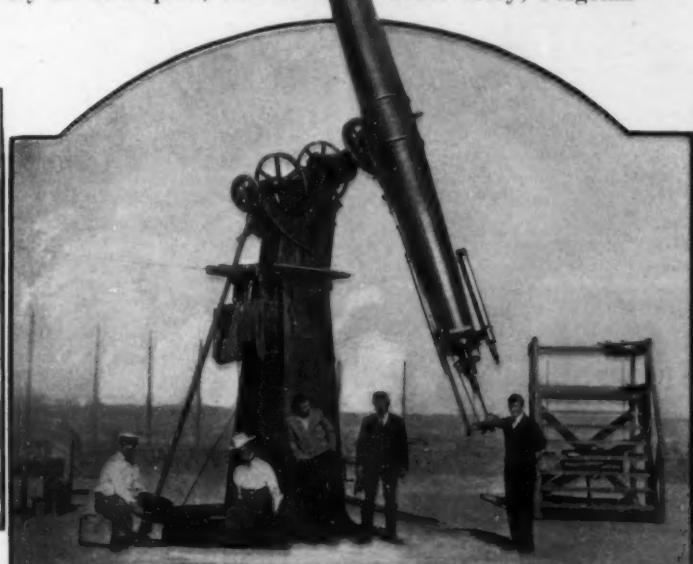
Corroborative Evidence

of Canals in That Planet

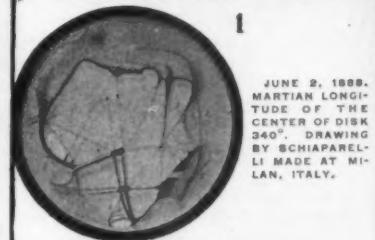
By E. C. Slipher, Lowell



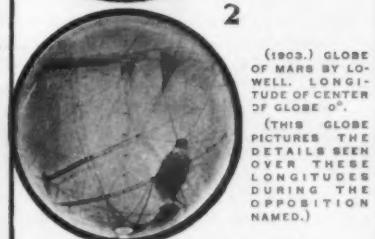
Dr. Percival Lowell.



E. C. Slipher.



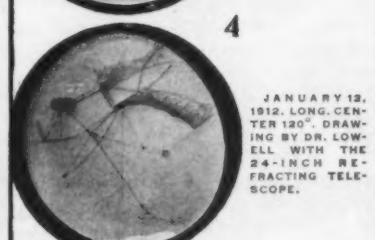
JUNE 2, 1888.
MARTIAN LONGITUDE OF THE CENTER OF DISK 340°. DRAWING BY SCHIAPARELLI MADE AT MILAN, ITALY.



(1903.) GLOBE OF MARS BY LOVELL. LONGITUDE OF CENTER OF GLOBE 0°.
(THIS GLOBE PICTURED THE DETAILS SEEN OVER THESE LONGITUDES DURING THE OPPOSITION NAMED.)



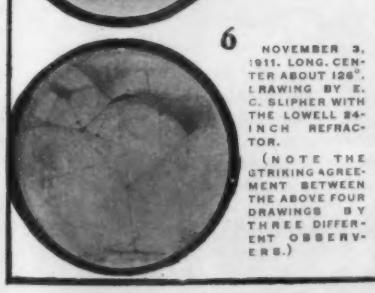
OCTOBER 21,
1911. LONG. CENTER 118°. DRAWING BY G. FOURNIER MADE AT SETIF, ALGERIA.
JARRY DESLOGES OBSERVATORY.



JANUARY 12,
1912. LONG. CENTER 120°. DRAWING BY DR. LOWELL WITH THE 24-INCH REFRACTING TELESCOPE.



OCTOBER 22,
1911. LONG. CENTER 111°. DRAWING BY G. FOURNIER MADE AT SETIF, ALGERIA.
JARRY DESLOGES OBSERVATORY.



NOVEMBER 3,
1911. LONG. CENTER ABOUT 126°.
DRAWING BY E. C. SLIPHER WITH THE LOWELL 24-INCH REFRACTOR.
(NOTE THE STRIKING AGREEMENT BETWEEN THE ABOVE FOUR DRAWINGS BY THREE DIFFERENT OBSERVERS.)

The 18-inch reflector of Amherst College mounted in Tarapaca Desert, at Alianza, Chile (1907), and members of the Lowell expedition.

No celestial body is of such world-wide interest as Mars. Ever since Schiaparelli discovered the famous "canals" and Prof. Lowell confirmed the discovery and supplemented it with other observations of equal importance, a controversy has arisen as to the interpretation which is to be given to the surface features of our planetary neighbor. Prof. Lowell believes that Mars is inhabited, and that the canals are the work of intelligent beings who seek to save themselves from destruction by an irrigating system far more elaborate than anything we have on the earth.

The accompanying article, prepared by Mr. E. C. Slipher of the Lowell Observatory staff, sets forth the reasons for supposing that Mars is indeed inhabited. Mr. Slipher has been for several years engaged in researches on Mars. His extensive visual and photographic study covers several oppositions of the planet, including that of 1907, when, as the observer of the Lowell expedition to the Andes, he observed the planet in the desert of Chile and brought back a remarkable set of drawings as well as photographs.—EDITOR.

PROBABLY no astronomical subject has created more popular interest or scientific discussion during recent years than has the question of the habitability of the planet Mars. The idea of the possible existence on another planet of life; of another world than ours where intelligent beings may now be living, has awakened, due perhaps to the human factor involved, great interest in the minds of both layman and scientist.

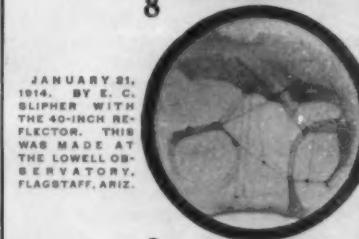
Early observers of the planet Mars—our near neighbor whose path about the Sun lies next outside that of the Earth—saw the polar regions masked with snowy white, and the intervening surface irregularly divided into widely extended light and dark colored areas. These great dark-blue expanses, because of their color and general similarity to our oceans, were believed by astronomers generally, prior to about 1890, to be large bodies of water and were termed accordingly "seas"; likewise the large reddish-yellow regions which constituted the greater portion of the planet's surface, from a similar reasoning, were considered "continents," and the smaller dark patches entirely surrounded by light areas were known either as "lakes" or as inland "seas," and the small light regions partially or totally encircled by the ocean waters as "peninsulas" or "islands."

Schiaparelli Discovers the Canals.

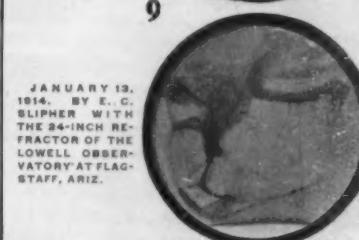
The year 1877 marked a new era in important Martian discoveries. During the planet's favorable approach to the Earth in that year Schiaparelli, the great Italian astronomer, while engaged in determining the Martian latitudes and longitudes of fundamental markings on the planet's surface in the preparation of an accurate aerographic map, discovered the "canals." As these newly discovered features matched in tint the lakes and seas, he naturally thought them to be channels connecting the then supposed seas across the land. For this reason they received from him the name "canale"—rivers or channels. In his subsequent memoir, in speaking of these linear markings he says: "Proctor's four great continents are now broken up into a multitude of islands, and it would seem that this work of cutting into small pieces must proceed yet further. No continuous great masses exist on Mars, but the entire dry surface of the planet is divided into an extraordinary number of islands. This peculiar and unexpected distribution of the seas and continents of Mars, which forms a striking contrast with what is seen on the Earth, is made evident at a glance at the map, whose network of canals must not be supposed to be complete; for it really includes only the heaviest lines and



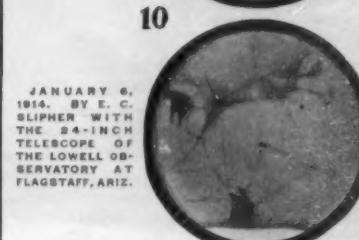
JANUARY 21,
1914. DRAWING
BY DR. PERCIVAL
LOWELL WITH
THE LARGE 40-
INCH REFLECTOR.



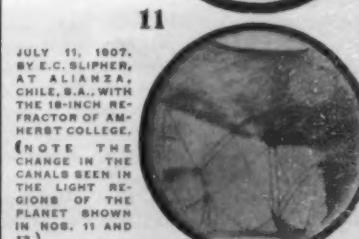
JANUARY 21,
1914. BY E. C.
SLIPHER WITH
THE 40-INCH RE-
FLECTOR. THIS
WAS MADE AT
THE LOWELL OB-
SERVATORY,
FLAGSTAFF, ARIZ.



JANUARY 13,
1914. BY E. C.
SLIPHER WITH
THE 24-INCH RE-
FRACTER OF THE
LOWELL OB-
SERVATORY AT
FLAGSTAFF, ARIZ.



JANUARY 6,
1914. BY E. C.
SLIPHER WITH
THE 24-INCH TE-
LESCOPE OF THE
LOWELL OB-
SERVATORY AT
FLAGSTAFF, ARIZ.



JULY 11, 1907.
BY E. C. SLIPHER,
AT ALIANZA,
CHILE, WITH
THE 18-INCH RE-
FRACTER OF AM-
HERST COLLEGE.
(NOTE THE
CHANGE IN THE
CANALS SEEN IN
THE LIGHT RE-
GIONS OF THE
PLANET SHOWN
IN NOS. 11 AND
12.)



JANUARY 20,
1914. BY E. C.
SLIPHER WITH
THE 24-INCH RE-
FRACTER OF THE
LOWELL OB-
SERVATORY,
FLAGSTAFF, ARIZ.

those most easily seen at such a great distance. Speaking of glimpses he had during his observations of October, 1877, upon two or three occasions of exceptional steadiness of atmosphere, he says: "Such, however, was the minuteness of the details, and so fleeting the duration of this condition of things, that it was not even possible to form a very clear and certain idea of the things seen, and there remained only a confused impression of a fine network composed of delicate lines and minute spots." He quotes a similar observation by Secchi on June 29th, 1858.

Although some objection¹ had been raised against believing dark regions of the planet to be due to water, these ideas of the constitution of the planet's features held for a considerable period. They were then most plausible certainly, since the most reliable investigations of that time led to the conclusion that the planet possessed a rather dense atmosphere. Not until the year 1892 was observational evidence secured that proved beyond doubt that the dark-blue regions of the planet were not seas of water. In that year W. H. Pickering observing at Arequipa, Peru, detected in these seas markings having permanent positions, which he called lakes and river systems. Douglass in the same year observed at the Lowell Observatory line-like markings in the dark areas of the planet which had the same geometric character as the canals and oases seen in the light regions. This marked a transition. Lowell then discovered that the canals had a faint and an intense period or a "live" and "dead" season, and in 1894 he announced the theory that the canals and lakes of Mars were not water, but strips and oases of vegetation sustained by an artificial canal system fed by the waters of the melting snow caps. This theory accounts for the remarkable changes occurring in the peculiar network of markings over the planet's surface, and as a fitting hypothesis to the observed conditions it has no competitor, satisfying as it does all the facts brought out by the observations. The observations indicate a close connection between the melting away of the polar caps and the intensification of the canal system; and as on the earth, the development of these marks of vegetation appear to follow loiteringly the march of the Sun as it passes—doubly slow as here on the Earth—from one hemisphere over the other.

Mars - A Planet That is Slowly Drying Up.

Older by cosmic eons than the Earth, and farther on in planetary evolution and development, Mars has but a meager supply remaining of either air or water. Therefore, it is supposed by Lowell that this network of canals and oases comprises an artificial system of irrigation intelligently constructed to utilize and distribute the water from the melting snows over the desert planet. The visible markings, of course, are not the actual waterways themselves, but blue-green strips of vegetation sprung from this irrigation. Two significant facts found by the observations here suggest, more than any other perhaps, their artificiality and otherwise substantiate his theory; first, the marked geometric directness with which the canals, in general, connect with the oases and isolated points, which makes them appear quite similar to a distant view of a system of many railways; second, the characteristic manner in which they seem to push out from, and develop with, the melting of the snow caps.

The observations of a number of astronomers evidence the fact that the canals and oases change, markedly, in intensity at different intervals. The photographs of these markings made here, confirm this. As early as 1877 Schiaparelli noted the disappearance of certain canals, but he attributed it to Martian clouds. Concerning this phenomenon, he says: "This variability I believe only apparent, and due to the passing of light clouds over the lands of Ophir and Tharsis." Water vapor was shown to be present in limited amounts in the atmosphere of Mars by photographs of its spectrum made at this observatory in 1908 and confirmed by many more obtained this year. However, Martian clouds are very rarely observed, and appear as dust storms seen along the terminator, so it seems that the changes he saw in the canals were not apparent and due to clouds as he thought, but real, and due to seasonal variations in the canals.

Schiaparelli never advanced the theory of artificiality of the Martian markings, but with the insight of genius and through open-mindedness he wrote, late in life, to

Lowell: "Your theory is becoming more and more probable."

I shall not pass unnoticed the fact that since Schiaparelli first saw the canals a spirit of skepticism has prevailed regarding their reality.² The observations of those who have seen the canals have met with considerable criticism and various theories of illusion have been expounded to explain away these details. However, much of this so-called criticism comes from those having very little if any first-hand knowledge of this branch of astronomical research. It is understandable why one inexperienced in this study would fear the chance of seeing illusory details, but practical experience in these observations will suffice to prove such a fear unwarranted. The truth is that illusions are not highly probable things, as some seem to believe, but, on the contrary, in actual practice to the trained eye they are found to be very highly improbable if not impossible. Experience enables one to distinguish the real from the fictitious at once, and the skilled observer does this unconsciously. Practical tests at the telescope are far better than any amount of theory or reasoning; and if those who devise and advocate theories of illusion to explain such planetary details would try practical applications to see where their theories lead, few if any would be mentioned. It seems both sufficient and necessary in this connection to state that almost all ideas of illusion have been investigated here in years past, and they have all been found defective or inapplicable, both by experiments and by the observations themselves.

As a matter of fact, all of these details, even the faintest canals, defy explanation as illusions. This is evident for two reasons. First, because they bear the

gros, France, and at Setif, Algeria. The success with which he has met in seeing these Martian features, and the striking agreement of his drawings of these details with those made here, are at once evident and remarkable. (See Figs. 3 to 6 in accompanying plate.)

With good seeing, good eyesight, and moderate optical power, these Martian details are not especially difficult objects of vision. The remarkable concordance of the results obtained by the many observers who give time to this planet shows that they see true markings. It is a significant fact that those who have sought out the best atmospheric conditions are seeing the canals best and in the greatest numbers. The crux of the situation is, it seems, that those who wish to discredit the existence of the canals will not make the conditions possible for their visibility.

It is found that by diaphragming the objective and by using a dark glass over the eye-piece of the telescope, the definition is markedly improved. Not only are the shaded glass and diaphragm correct in principle, but are proven in practice to be important aids to seeing planetary detail. With a magnification of nearly 400 on Mars the best results are usually obtained with apertures of from 12 to 18 inches. This same magnification which is the one most used gives an image of the planet at its near approach to the Earth, whose surface is about twenty-five times as great as that of the Moon viewed with the unaided eye.

If telescopes of large apertures fail to reveal the canals and oases of Mars to an observer of good eyesight under favorable conditions of atmosphere, it must be due either to insincerity of purpose or to the disregard of such principles as mentioned above. They have been seen here with both the 24-inch refractor and the

40-inch reflector, and with apertures anywhere between 6 and 40 inches. They were also seen by me through the desert air of the Tarapaca in Chile, with a three and one half inch telescope and with the excellent 18-inch refracting telescope of Amherst College. This forms conclusive proof that they are not functions either of reflector, refractor or of aperture.

Furthermore, an absolutely incontestable proof of the reality of the canals and oases of Mars is furnished by the photographs of them. The size of these photographic pictures of Mars, taken when it is near the Earth, is from four to six times greater, in surface, than the Moon to the unaided eye. True it is that the markings on the planets cannot be photographed as clearly as they can be seen visually, due to the fact that the sensitive emulsion of the plate requires a longer time to receive its impression than does the eye, and consequently the resulting photographic image is subjected to more atmospheric disturbances and becomes more or less blurred; but in spite of this great handicap, a majority of the canals and oases have left their impression on the photographs. Some of the double canals have also been photographed as such.

About twelve or fifteen would perhaps be a fair average of the number of these markings visible on a plate of a single region of the planet. Thus, many of the canals and oases have been recorded on the photographs, not once, but many hundreds of times over, by the tens of thousands of photographs obtained here since Lampland first succeeded in photographing them in 1905. Aside from this corroborative evidence, they also show the distinct changes in the intensity of these markings which occur from time to time.

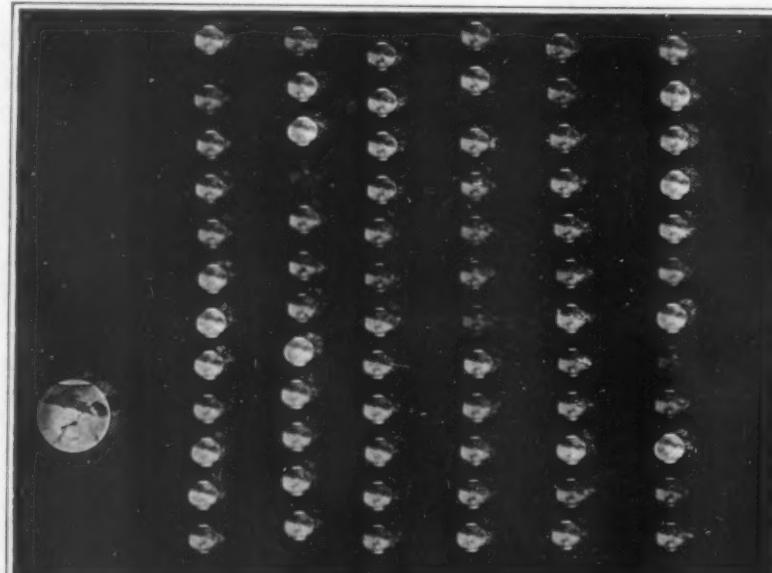
There is nothing in terrestrial topography or the markings on other planets that is comparable to the markings on Mars. In all, about seven hundred canals and oases have been observed here in the complicated network which covers the planet's surface.

We are no longer concerned with the discovery of new markings, but are pursuing a more detailed study of their appearance and behavior in search of the key to this most engaging riddle of the solar universe.

Windmill with Emergency Connection to a Stationary Engine

WIND-POWER is one of the cheapest forms of power at our disposal. Unfortunately, it has the serious drawback of being irregular and intermittent in character. This defect is overcome at some German flour mills, according to *Prometheus*, by running a windmill in conjunction with an engine, which may either supplement the power of the wind continually, or only at times when there is a more or less complete deficiency.

¹Inability to see an image of the Sun reflected by the Martian waters.



Drawing of July 12th, 1907, by Dr. Lowell, at Flagstaff.

Photograph made July 13th, 1907, at Alianza, Chile, with the Amherst College telescope, by Mr. E.C. Slipher. The details in the photograph cannot be reproduced by the half-tone process, but the Editor of the "Scientific American" has seen the oases in them.

same stamp of reality as the obvious details; secondly, because a canal that is at one time quite faint becomes at another period so markedly intense as to rival in visibility any detail on the planet.

Why Good "Seeing" is Necessary.

Favorable conditions of atmosphere are of course the essential factor in observations of the surface details of planets; second only to this stands the importance of eyesight. By good atmospheric conditions is not meant clear skies only, but rather the tranquillity of the air; upon the latter depends the clearness and steadiness of the telescopic image. It is also true that the greater the aperture of the telescope objective, the greater the disturbing effect of the atmosphere and the less well defined the image of the planet will appear. Thus it will be seen that what is seen on the planets is limited first of all by the condition of the air through which we must observe rather than the size of the telescope. It should be noted in this connection that the Lowell Observatory was located at Flagstaff—elevation, 7,250 feet—after investigating atmospheric conditions at many other places. The only other telescopes of which I am aware that have been located after such a search for excellent conditions of atmosphere are those at the observatories of Jarry-Desloges at Masse-

²As an illustration of this absurd skepticism a late book "Astronomy—A Popular Handbook," by Prof. Jacoby of Columbia, in treating the Mars subject, says: "The polar spots seem to increase in the Martian winter season, and to diminish in the summer." That the polar caps do change in this precise manner is an observed fact, and has been known since instrumental means made such observations possible a half century or more ago.

The New York Electrical Exposition

WHILE the New York Electrical Exposition which is now open at the Grand Central Palace (October 7th to 17th) does not feature any of the heavy machinery for producing electricity, the multitude of applications shown strongly impresses on the visitor the almost unlimited usefulness of this wonderful agent; for no matter what his occupation or interests may be, something will be found in this unique collection of electrical appliances that will appeal to and interest him.

As in previous years, the Government has contributed liberally in exhibits of popular interest, and the electrically operated mint, which illustrates practically every operation in the production of a twenty-dollar gold piece; and the exhibition of the electrical equipment of a battleship, are again to be seen, as well as the machines employed by the Bureau of the Census. In addition, there is an electrically operated series of cartridge-making machines from the Frankford Arsenal, that will be shown at the Panama-Pacific Exposition, and which shows the various processes for making both rifle cartridges and those used in rapid-fire guns. The War Department has a most interesting and timely exhibition of field signaling methods as employed by the United States Army, including a hand-operated generator so small and compact that it can be carried on the back of a mule, and yet powerful enough to be of most valuable service in a campaign. In this connection it may be noted that in the Navy exhibit there is a wireless outfit, such as is used on all war vessels, in actual operation, and the visitors can hear actual messages being transmitted both between the various naval stations and between the men-of-war in this vicinity.

In the department of commercial exhibits there hardly is an industry that has not profited and been simplified by the aid of electricity, and while there is a host of apparatus that will interest the user of power in every direction, there is an equally large number of applications in the affairs of every-day life that will appeal to everyone. The restaurant is there, with its electrically operated ranges and other labor-saving devices, as well as the dairy, with its real cows that are milked by electric power, and the processes of pasteurizing, bottling, and butter making are there, electrically conducted, as well as a complete ice cream plant. A novelty is the bakery in full operation, turning out a variety of attractive cakes, all of the operations of sifting the flour, mixing the dough and baking, as well as other subordinate operations, being performed with the assistance of electric power.

To the New Yorker who is accustomed to seeing men at frequent intervals working over a maze of wires in excavations and manholes in the street the exhibition illustrating the construction of the subways in which the thousands of miles of wires for the telegraph, telephone, power and many other purposes are accommodated will be of particular interest, as they convey some idea of what these men are doing and how these wires are laid. And an especially interesting feature of this exhibit, which includes actual specimens of the underground constructions which enable this distribution of electricity to be made, is a model showing a specimen of the sub-surface constructions that exist under the streets of a city, making it evident that the ground beneath the surface is often fully as crowded as the street above, and by no means in as orderly a manner. One of the most sensational pieces of apparatus shown is an oscillating transformer outfit for testing the big porcelain insulators that are used on long-distance transmission lines, although it can also be applied to the testing of almost any insulating devices. A defective insulator on such a line not only means a wasteful loss of current, but is often an element of danger where high-tension currents are being transmitted, and the expense of searching these out and replacing them is considerable. By means of this compact testing set, which takes 2½ kilowatts from a 60-cycle, 110-volt circuit and delivers it at 125,000 volts, the largest and most expensive insulators can be satisfactorily tested, and all its weak points searched out without injury. To see this outfit in operation, with the great crackling across its sphere gap, is an object lesson to the uninitiated.

Of lamps of every size and description there is no lack, as well as many kinds of batteries; and these lead to the very practical display of commercial vehicles, which put forth strong claims for simplicity and convenience. Another device that appeals to the public is a water sterilizer that acts directly on the water as it is delivered, the operation of turning on the water also starting the sterilizing apparatus, which operates by the application of ozone. So efficient is this system claimed to be that it will, in a large apparatus, completely sterilize the worst sewage. Another every-day outfit is the barber shop, in which electricity furnishes hot water, a steam sterilizing drum, vibrators, and a hair singeing device.

Of the household devices there are legions, all tending to simplify and lighten the work of the family, and

consequently universally attractive; but among these there is little of novelty, except it be in refinements. Taken as a whole, this exhibition, while interesting and instructive to the electrician, is particularly attractive to the layman, and probably this is the direction of the greatest value in shows of the kind.

Electric Death

A Suggestion for Its Prevention

By Phillip E. Edelman

THE writer happened to be on hand at one of the recent accidental electrical deaths and feels that many of these family robbing incidents could be easily prevented. It was the old story of the 2,000 volt line not being a sufficient distance away from surrounding trees, barns, etc. The unfortunate victim was caught while engaged in the work of trimming a tree, the 2,000 volt line being substantially in contact with the tree.

Now, aside from these occasional and too frequent accidents, the writer, and doubtless others, has noticed that there is a grounding at many points where such wires touch tree tops; sparks may often be seen passing between the wires and the branches of the tree.

With the knowledge that higher poles are more expensive and that underground conduits are very costly, the writer would still suggest that every municipality granting right of way for a high voltage line should require such wires to be separated from all surrounding objects by a distance of not less than eight or ten feet. This may mean the use of higher poles at parts of the line or even lengths of insulated cable, but the cost would be offset by the consequent freedom from line loss, danger of breaking wires, and still more, in the saving of valuable civilian lives.

The public ought to realize that the same wire which may only be three sixteenths of an inch in diameter and look very innocent, is capable of transmitting many kilowatts instantaneously to a human body, and comprises, in fact, a high power death-dealing electric gun. Two thousand volts at only 1 ampere is equivalent to the force of more than two horse-power; applied electrically to a small portion of a body, it acts much like a bullet as far as its power effect is concerned.

The writer has been informed by a transmission line engineer that foolish huntsmen constitute a menace to high tension transmission lines, because with the cowardly bravery of non-publicity they shoot at and hit the life and line-saving insulators. So far has this menace proceeded that special steel-clad bullet-proof insulators have had to be designed. The repair of such a high tension line is no child's play, and the foreman takes considerable responsibility when he sends back word to the power-house that the line is clear. Should a single lineman remain on the pole when the 13,200 or higher voltage supply is turned on, instant death is a probability.

Again, it should be said, "Respect, don't fear, electricity, but use every precaution for safety." It is not safe to have a loaded gun pointed at a good citizen; it is no safer to expose him to the bare or insufficiently insulated "electric gun." The use of electricity is entirely safe if only it is properly transmitted and applied; misused it has no mercy and spells DEATH.

Sex Differentiation

IN his presidential address before the British Association for the Advancement of Science, at Melbourne, Australia, Prof. William Bateson in discussing Heredity considers how the characteristics of a population of differentiated members would be distributed among their offspring, and he has the following to say in relation to this problem: "Formerly it was hoped that by the simple inspection of embryological processes the modes of heredity might be ascertained, the actual mechanism by which the offspring is formed from the body of the parent. In that endeavor a noble pile of evidence has been accumulated. All that can be made visible by existing methods has been seen, but we come little if at all nearer to the central mystery. We see nothing that we can analyze further—nothing that can be translated into terms less inscrutable than the physiological events themselves. Not only does embryology give no direct aid, but the failure of cytology is, so far as I can judge, equally complete. The chromosomes of nearly related creatures may be utterly different both in number, size, and form. Only one piece of evidence encouraged the old hope that a connection might be traceable between the visible characteristics of the body and those of the chromosomes. I refer, of course, to the accessory chromosome, which in many animals distinguishes the spermatozoon about to form a female in fertilization. Even it, however, cannot be claimed as the cause of sexual differentiation, for it may be paired in forms closely allied to those in which it is unpaired or accessory. The distinction may be present or wanting, like any other secondary sexual character. Indeed, so long as no one can show consistent distinctions between the cytological characters of somatic tissues in the same individual we can scarcely expect to perceive such distinctions between the chromosomes of the various types."

Of course, I realize fully that whoever put that subject in had little thought of the embarrassment it would cause me or he would not have done it. You would be surprised to notice how a thing like that attracts attention, for at least a dozen persons have already spoken to me about it. It came in as particularly inopportune because we recently sent out a circular in which we used the word "El Dorado" and emphasized the fact that there was no such condition of commerce in Latin America. Then, again, in the meeting the other day of the National Committee appointed by Secretary Redfield to consider the trade situation in Latin America, I made a particularly earnest appeal to the business interests of the country to prevent the idea spreading throughout the land that there was an El Dorado for American commerce in these countries. All this will enable you to see that my embarrassment was quite acute,"

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

An Opinion of Our War Number

While I have already expressed it verbally, I want to put in writing my appreciation of the War Number of the SCIENTIFIC AMERICAN.

It is full of just the sort of information that I shall want to keep right at hand for reference many times during the progress of the conflict. It is all handled in a very effective and interesting way.

EDWIN A. WALTON,
Advertising Manager of Timkin Roller Bearing Co.
Detroit, Mich.

Rabbits in Oil Pipe Lines

To the Editor of the SCIENTIFIC AMERICAN:

I note in the issue of your paper of the 22nd ultimo an article entitled "Strange Animal Tragedies," that I inclose, stating that in the process of laying the pipe lines of the Midway Field the lines have to be taken up to take out the rabbits. This is rather misleading. The rabbits do get into the lines, but in the process of laying pipe for many years, there is one man assigned to the duty of carefully examining every joint just as it is screwed to the last just laid, to see not only that there are no animals in it, but also, what is much more likely, that there is no dirt in it, and pipe-lines are not taken up to take rabbits out of them, as the last part of the article would indicate was a common practice. The duck part of the story is correct. They do alight on the oil, thinking it water, and usually perish, notwithstanding that there is a lake six miles wide within seven miles of and in plain sight of the oil ponds.

Taft, Cal.

J. W. SQUIRES.

The Indomitable Engineer

To the Editor of the SCIENTIFIC AMERICAN:

I have read with interest your editorial of the 22nd ultimo, entitled "The Indomitable Engineer." The engineer until quite recently has received but little praise or reward for his great share in the upbuilding of our comparatively new and great country. Even in our times, his projects and improvements began with pioneer work in road and railway building, and have reached a consummation in such impressive works as the Panama Canal, the Pennsylvania Tunnels and Hell Gate Bridge, and great buildings, bridges, and subways, excellent examples of which will be found in New York city.

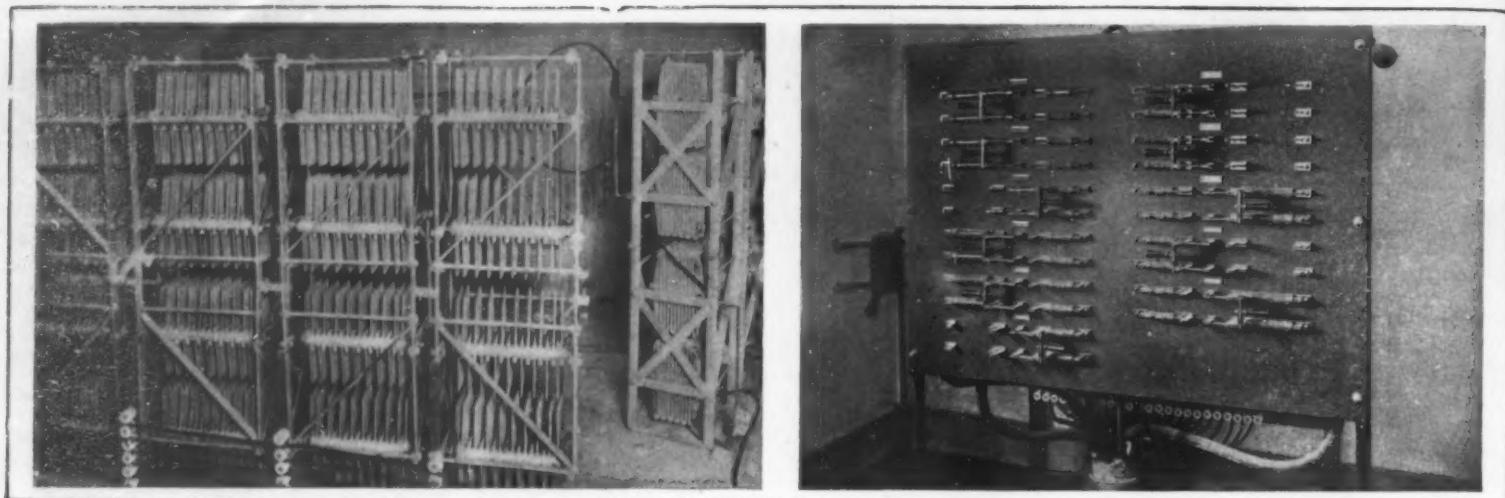
In the illustration you take of our Hell Gate Bridge across the East River, your appreciation of the unnamed engineer, Gustav Lindenthal, is exceedingly well deserved. His persistency, resourcefulness, and ability to surmount any engineering difficulty entitle him to be regarded as one of the great engineers of the present generation.

A. J. COUNTRY,
Special Assistant to President of the Pennsylvania Railroad Company.
Philadelphia, Pa.

Our Latin American Opportunity

UNDER the above title we published in the SCIENTIFIC AMERICAN of October 3rd, an article by John Barrett, director-general of the Pan-American Union. By an unfortunate slip, the sub-title "An El Dorado for Our Business Men" was used. This was done entirely on our own responsibility and without permission of the author. It expresses an attitude entirely at variance with that of Mr. Barrett, who has been emphatic in stating that the field is in no sense an El Dorado, but simply a great legitimate, natural opportunity, which, however, is suffering from serious financial stringency. In calling our attention to the sub-title, Mr. Barrett writes:

"Of course, I realize fully that whoever put that subject in had little thought of the embarrassment it would cause me or he would not have done it. You would be surprised to notice how a thing like that attracts attention, for at least a dozen persons have already spoken to me about it. It came in as particularly inopportune because we recently sent out a circular in which we used the word "El Dorado" and emphasized the fact that there was no such condition of commerce in Latin America. Then, again, in the meeting the other day of the National Committee appointed by Secretary Redfield to consider the trade situation in Latin America, I made a particularly earnest appeal to the business interests of the country to prevent the idea spreading throughout the land that there was an El Dorado for American commerce in these countries. All this will enable you to see that my embarrassment was quite acute,"



Electric heating units in the furnace room.

Switchboard in the principal's office.

The Electric High School

A Building Heated by Electricity

By G. L. Dilworth

TO the high school of Rupert, Idaho, belongs the distinction of being the first large building in the world to be exclusively run by electricity. In this building electricity is also used for a wide variety of other uses, and hence it has come to be called the "Electric High School."

Rupert is the metropolis of the Government Minidoka Irrigation Project on the Snake River, a region which eight years ago was a sage brush desert, but which now is a densely settled farming community, forming the new county of Minidoka with Rupert as its county seat. The settlers on this project are intensely progressive and are determined to have for themselves and their children advantages, especially educational advantages, that will equal those of the best and most progressive cities of the country. For this reason they have provided buildings, equipment, courses of study, and teachers equal to the best. Special instructors are provided for cooking, sewing, manual training, music, drawing, athletics, etc., and all courses are designed to meet the modern idea that they must be practical and of practical benefit.

"The Electric High School" is a three-story building built of mottled-buff pressed brick. On the ground floor there are manual training rooms, equipped with a 10 horse-power motor for driving the ventilating fan and providing power for the lathes, saws, and other machinery necessary in this department, and benches with all tools and equipment necessary for a class of twenty at a time; a sewing room; a cooking room with electric disk stoves

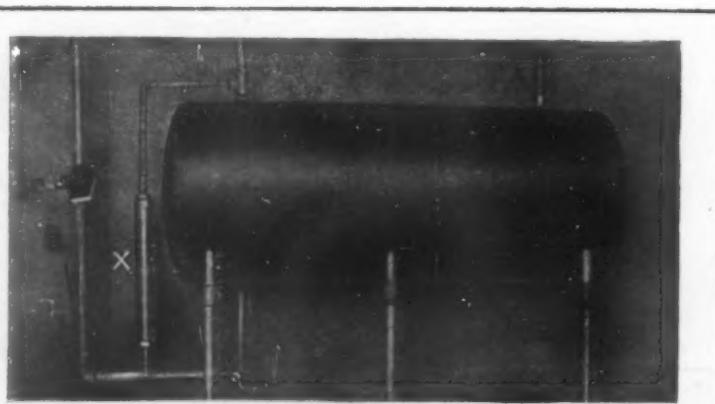
and cooking utensils for a class of twenty girls at a time; a cafeteria lunch room; a large gymnasium with galleries for spectators the full length on each side and the open corridor across one end; janitor's supply rooms; transformer room; electric furnace room; plenum chamber; agriculture room; and on opposite sides of the gymnasium dressing rooms, shower baths, and sanitaries for boys and for girls.

On the first floor are library; class rooms; principal's office; ladies' rest room; cloak rooms; and auditorium and stage and dressing rooms.

On the second floor are two class rooms, five recitation rooms, and laboratories, cloak rooms, boys' and girls' sanitaries, and janitor's supply room. The science rooms on this floor are exceptionally fine, consisting of a lecture room with raised seats and, on one side, a chemical laboratory with hydrants and locker space for a class of twenty performing individual experiments at a time, and on the other side a laboratory for physics and botany with dark room adjoining for photography. Glass and paneled partitions separate the laboratories from the lecture room.

The auditorium is seated with 380 opera chairs, and has a large stage for theatricals. The electric lighting for the stage is especially fine, being said to be equal to the best theaters. An outlet at the back of the rooms is provided for the use of stereopticon or moving picture machine. The science lecture room is also equipped for the use of the stereopticon and for obtaining current for electrical experiments.

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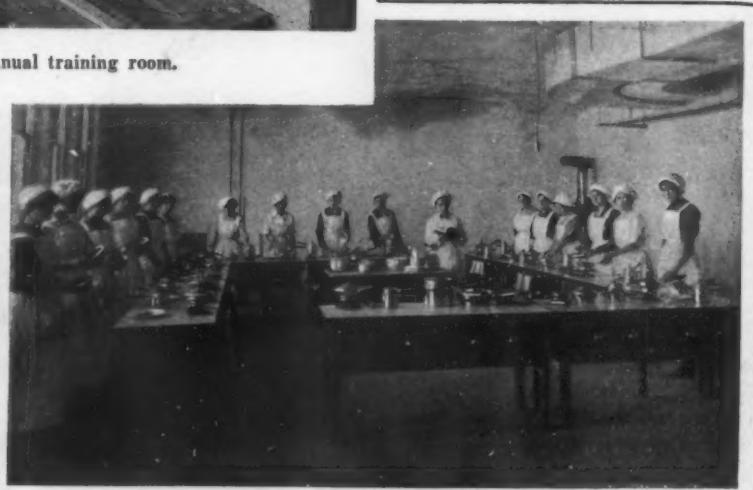
Hot-water tank in the plenum chamber.



A corner of the manual training room.



Chemistry room, where electricity is largely used.



Cooking room, fitted with electric stoves.

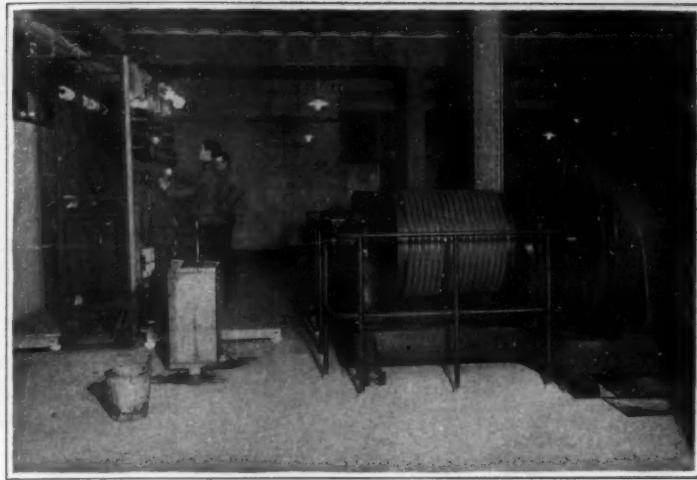


Fig. 1.—Dynamo machinery at Eiffel Tower.



Fig. 2.—Transmitting keys and control boards.

Radio-telegraphy at the Eiffel Tower

The First Station of an Interconnecting Chain Linking French Possessions

By John L. Hogan, Jr.

FOR several years the republic of France has been working toward the erection and operation of a state-owned chain of powerful "wireless" telegraph stations to interconnect Paris and the French possessions in Africa, Asia, America, and Oceania. Although the unfortunate complications which arose in the planning of England's Imperial Wireless Chain have been avoided, there have been many delays, and numbers of people are inclined to blame various political and cable-telegraph interests for the slowness in arriving at necessary decisions preliminary to plans for construction. The European nations bear in mind the need of instant communication between the colonies and from them to the capitals, and feel insecure so long as they must depend entirely upon cables. In time of war, when attempts to enforce isolation of distant military forces by the cutting of pole, underground and submarine wire lines are among the first steps of an attack, radio-telegraphy may be depended upon, since the entire plant is localized and may be protected far more efficiently than may any long conductors. Since war clouds are ever present, at least in imagination, speed of erection and in beginning telegraph service has been a first consideration in the several government plans for covering large spans on the earth's surface by radio.

Like other nations, France has had before her the difficulty of deciding upon the proper and best "system" of radio-telegraphy to adopt, and this need of making a choice among the several manufacturing corporations is said to have been the actual reason for delay. It is realized that communication, to be dependable for military as well as civil uses, must be of a

sort entirely comparable to that given by cables under favorable conditions. Since the French plan embraces pairs of stations separated by distances as great as 9,000 kilometers (5,600 statute miles), from Guadeloupe to the Marquesas, and 6,800 kilometers (4,200 statute miles), from Paris to Guadeloupe, it is essential to select and plan the proposed stations with great care. At present the longest spans covered by "wireless" commercially are between the Marconi stations at Glace

Bay, Nova Scotia, and Clifden, Ireland, some 2,000 miles, and by the Poulsen stations at San Francisco and in Honolulu, about 2,300 miles. These pairs of stations exchange messages regularly, but have been sometimes forced to repeat or even to suspend communication temporarily because of severe atmospheric disturbances. The new Goldschmidt stations at Hanover, Germany, and Tuckerton, N. J., are said to have a commercially reliable radius of 4,700 statute

miles which separates them. But no one has yet demonstrated the feasibility of regular signaling any farther than 2,500 miles, much less across stretches of 5,000; the difficulties become rapidly greater as the separation increases beyond 2,000 miles, and new problems are brought into the design of apparatus. It is believed by advanced radio engineers, however, that even such great distances as 5,000 miles may be covered dependably by a proper selection of instruments and methods which have already been developed, but which are not widely known.

At the base of the Eiffel Tower, in Paris, the government has maintained for many years a military and experimental radio station, and it is here that tests are proceeding with a view toward determining the best types of apparatus for the new high-powered stations. At this station the antenna wires, which are limited in number to six, so as not to deface the tower and Champ de Mars, run from the apparatus house built underground to the tower top, in an inverted fan arrangement. Although the aerial is thus made smaller than it might be if strung from a mast built especially for "wireless," the great height which is reached (984 feet)

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Fig. 3.—The rotary spark gap.

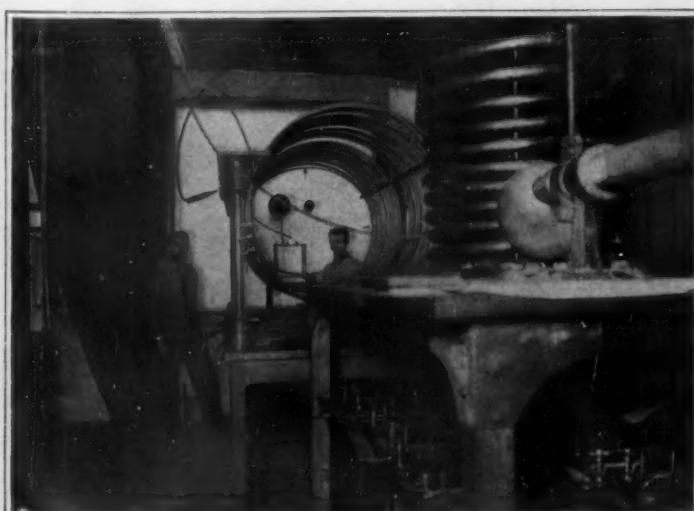


Fig. 4.—Inductance coils and spark gap.



Fig. 5.—Condenser jars, blower and inductance coil.



Map of western theater of the war.

Strategic Moves of the War

Letter from the Military Expert of the Scientific American, October 10, 1914



Map of eastern theater of the war.

The French Campaign

OCTOBER 10th makes four weeks that the Germans have been holding the line along the Aisne River, the Argonne, and the French border departments. When they first fell back to this line they had the choice between two plans for the strategic use of their military forces. One was to hold the lines in France with minimum force while concentrating their efforts for a time against the Russian invasion, while the other was to use the strongly entrenched lines of the Aisne as a base from which to attempt a new move against the French and British armies.

After the battle of the Marne the French required time to organize their forces and to get started on their aggressive campaign. The Germans seem to have expected this, and to have taken advantage of it to reform their lines and to divert their strength for a time to the eastern field of operations. It is not believed that any German corps were actually transferred from France to East Prussia. This is very unlikely when Germany had large forces of reserves at home ready to move to the front. The diversion of force came from sending to the east even the reserves that would normally have gone to strengthen their local corps in France.

This reinforcement of the German armies in the east enabled them to drive the Russians out of East Prussia and to force them sixty miles beyond their border to the Nieman River. At the same time the Germans pushed forward their armies in Poland to a line running near Plock and Kielce.

The development of the first turning move of the Allies recalled the German efforts to France. They were confronted with two dangers. The turning move, if successful, would force their retirement from their position, won at such great cost. The advance of the French against the German fifth army in the wooded hills northwest of Verdun threatened to cut the German line in two, with much more serious possibilities than the turning move. The first effort of the Germans was to check these two strategic moves of the Allies.

The forces near Rethim were pushed forward in a demonstration to lead the Allies to strengthen this part of their line. Reserves were rushed to the fifth army to enable it to hold its ground. In the north, especially, the Germans were hard pressed to muster the forces needed to oppose the Allies' enveloping attack. This they did by throwing into the front line the reserves from the center of their line, by rushing to the flank a part of their army from Belgium, and by stripping the captured French cities of their German garrisons. Especially was their line strengthened by reserve corps newly brought from Germany, that were rushed to the front by marches that may prove to have set new records for distance and strength of force.

Checked in this first attempt of the army of Gen. d'Amade to reach the German rear, the Allies reverted to an extension of their original project. New corps were rushed to the north behind the shelter of the troops already in line, and the Allies' flank was extended north of the Somme River. Checked again at Albert and Bapaume, the maneuver had to be pushed still further.

For the past ten days the British have been moving to the continent their second contingent. When the proclamation of war was issued by the King on August 4th the army reserves, the special reserves, and the territorial forces were called to the colors. A day or two later Parliament authorized 300,000 volunteers.

In military organization Great Britain has practically the same system as the United States. In fact ours is

inherited from them along with the majority of the basic legal and social principles on which our governmental organization is founded. The territorials correspond to our militia, except that the British territorials may be called out for service anywhere in the Empire. The army reserve is composed of ex-soldiers; the special reserve is composed of civilians of special training. Both reserves join the regular army on call for active service; in these only does the British service differ markedly from ours.

From the volunteers and from the detachments of regulars gathered in from all parts of the Empire, Great Britain must by now have organized a new army for service on the continent. Rumors of the move to the front of such a force have come through, but no inkling of its destination. The extension of the left flank of the Allies to the vicinity of Lille indicates the probability of this new British army on the extreme left flank.

To defeat this further extension of the enveloping move of their opponents the Germans attempted the maneuver of breaking through the French line to get in rear of their flank. From the 1st to the 6th of October they made desperate assaults on the lines between the Somme and the Aisne and forced the French back to new positions in rear. They were unable, however, to break through. In order to check the German attacks the French had to divert to this field some of the forces intended for extending their flank. The German assaults were to this extent successful in crippling the turning move of the Allies.

Germany is now sending her cavalry into the fight to stop the Allies' turning move. These troops are of little value in the close fighting of the general line of battle. But on the flank their mobility makes them of especial importance. It was by an army of 70,000 men that Gen. von Kluck protected his move during the rapid advance into France of the first days of the war. The French and British have for similar reasons pushed their cavalry forward to their extreme flank, which district will soon witness some of the greatest mounted conflicts of recent centuries. While making every effort to foil the threatening moves of the Allies against their northern flank, the Germans have also been trying out the south flank of the French line. By the use of their heavy 11-inch field mortars they have brought a fire to bear upon the line of French forts along the hills on the east side of the Meuse, south of Verdun, that has enabled them to break through the first line of defense. The capture of Fort Camp des Romains at St. Mihiel and the silencing of the forts on either side enabled the army of the Bavarian Prince Rupprecht to push forward to the Meuse River, where they have interrupted the principal supply route for Verdun and the French line to the south.

The object of this assault is not to open across the Cotes de Meuse a route for the main armies to advance. It is rather to get behind the French line in sufficient force to open up to the north or south the routes for the final advance. The strengthening of the French line at this point has thwarted this plan.

The continuous extension to the north of the lines of the opposing forces must be to some extent at the expense of their southern flanks. If much farther continued, the Allies may take advantage of their numerical superiority to work the same maneuver against the German south flank. Such a move would be against their fixed policy, which is to maintain connection with the North Sea ports, but it might be adopted for one move of the campaign.

When the Germans found their first dash into France checked while the Russians were making a victorious

advance into East Prussia and Galicia, their general staff had to decide whether to remain on the defensive in the eastern campaign or to adopt the offensive at the expense of the French campaign. It was impossible to make an overpowering effort in both directions, while an equal division of forces would invite disaster in both theaters of operation. Apparently they adopted an intermediate policy. Due to an expected slowness in the aggressive operations on the part of the French, the Germans took advantage of the lull in operations in France to strike a blow to the east. Their central position and their highly developed railway system aided this plan of operations and gave them an appreciable advantage in that they can concentrate the majority of their forces first on one border and then on the other as the progress of the campaign may demand.

This is the strategy that appeals to the Germans. It is that which won success for their king and hero, Frederick the Great, whose campaigns are the pride and boast of every German. By making use of Prussia's central position and the mobility and efficiency of her troops Frederick fought off the attacks of enemies on all sides and turned over to his successor an enlarged and strengthened kingdom. Especially was this advantage of a central position exemplified in his strategy in the seven years war of 1756 to 1763. An echo of this appeared in America in the French and Indian war, in which Washington's military genius showed itself in the salvation of the British column after Bradock's defeat near the present city of Pittsburgh.

In 1756 Maria Theresa, Empress of Austria, succeeded in forming a coalition of Austria, Saxony, Sweden, and Russia, to crush Prussia and return to Austria the province of Silesia that had been wrested from her in the war of the Austrian Succession in 1741-1745. The following year France joined the coalition and Frederick was confronted with a strong army advancing from the west while he was battling with the Austrians and Saxons in Silesia. In both fields the hostile armies largely outnumbered the total Prussian military strength.

To combat these armies that might have crushed him by mere weight of numbers if they had been allowed to unite, Frederick abandoned the field to the Austrians and moved every unit westward to oppose the French. He concentrated his forces at Rossbach, and on November 5th, 1757, signally defeated the French, though outnumbered three to one.

Leaving the fragments of the French army unopposed, Frederick again collected his forces and hastened back to Silesia to confront the Austrians. This march of 300 miles after a hard won victory over superior numbers is one of the noted military movements of history. Just one month after Rossbach, on December 5th, 1757, Frederick met the Austrians at Leuthen, near Breslau. With 30,000 Prussians he defeated 80,000 Austrians and captured 21,000 prisoners.

By a continuation of such tactics he was able to stand off his powerful adversaries with such effect that in the final peace Prussia was confirmed in the possession of Silesia. It is by similar movements, much facilitated and expedited by rail and automobile service, that the Germans hope to obtain favorable outcome in the conflict with a similar array of enemies.

Having turned their strength to East Prussia the Germans found that the Russian advance was largely a demonstration. The superior strength of the German forces rapidly forced the Russians back to the Niemen River. Here the German left flank threatened Olita, on the Niemen, 60 miles north of Grodno, while

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German gun for bringing down aircraft.



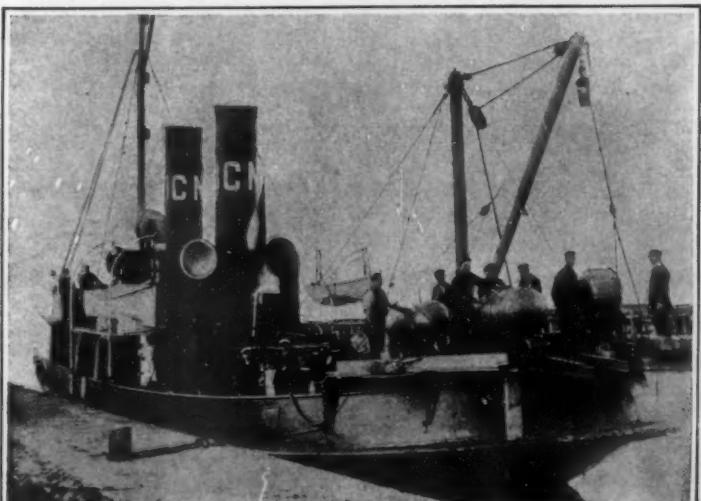
Commandeered British motor truck.

Copyright by International News Service.
Wreck of a French monoplane near Namur.Copyright by International News Service.
Unexploded German shells found after the battle of Marne.

A steel bridge at Lagny destroyed by the French.

Copyright by Underwood & Underwood.
Wreck of a French Red Cross train and the Mary bridge across the Marne.

A German motor convoy destroyed by French dragoons.



A German mine-laying ship leaving Wilhelmshaven.



Country around Antwerp flooded by cutting the dikes.

Our Merchant Marine—Past, Present, and Future

III.—The Future

By Winthrop L. Marvin, Author of "The American Merchant Marine. Its History and Romance"

IN two earlier articles, the splendid growth of the American merchant marine through the first half of the last century, and its subsequent decline, have been described, and the present pitiable weakness of our merchant fleet in overseas trade—in contrast with the vast size of our coastwise fleet—has been considered.

What, then, of the future? Are there any new or old national policies that can be invoked to give the United States the place to which it is entitled on the ocean? For one thing, an experiment in free ships is now being tried. From the year 1789 to 1912 American registry as a general rule had been denied to all ships that were not of American construction. The purpose of this policy was to shield and encourage American shipyards, so valuable to the national defense. The motive was good, but the method was ineffective for the large development of a merchant marine. It was as if there had been a prohibitory tariff duty upon the machinery of textile or other mills, with no duty on or protection for the products of that machinery or industry.

Ships are the machinery, or the tools, of the ship-owner's trade. He will buy and use that machinery, or those tools, only if he can conduct a profitable business. Otherwise he will not be able to purchase and employ them, and a sheer prohibition on their importation from other lands will be a matter of mere academic interest.

So it has been with prohibition of import, or American registry, of foreign-built vessels. Of itself and by itself, it has been impotent to make American shipyards prosperous or to create a great American merchant marine in overseas trade—which is primarily a problem of profitable shipowning or operation. There has been a great deal of confused thinking and writing on this subject, and even now the assertion is often made by some public man or newspaper that American ocean shipping has been "protected to death"—whereas it has never—in our time, been protected at all. Neither a protectionist policy nor a free trade policy has been consistently applied and tried, and the result has been precisely what might have been anticipated.

In the beginning—as has been shown in a previous article—the national policy was a wholly sane and consistent one. That was the policy of Washington, Jefferson, and Madison. Under their laws, that proved so wonderfully successful, American registry was given only to American-built ships, but preference in employment was absolutely guaranteed to those ships by a differential customs duty of 10 per cent on their import cargoes—by an even greater differential in the rich East India trade—and by heavily discriminating tonnage taxes. That is, both shipbuilding and shipowning were powerfully aided and encouraged by the Government. Later, when the preferential policy and the modern mail subsidies were swept away and ocean shipowning was left a completely unprotected industry, the prohibitive protection on shipbuilding remained. That was only one half of the "policy of the fathers," and the less vital half, and, of course, it was utterly ineffective. It could not possibly have been otherwise.

There was, however, this important qualification, that the coastwise trade remained wholly reserved to American ships, and finally American ships were built only for this coastwise commerce. This part of the original historic policy has never until this year been seriously attacked. It was assailed in a very formidable way by a proposal, in connection with the war emergency shipping legislation of last August, to admit foreign-built vessels to the coastwise trade, but the plan was overwhelmingly defeated in the Senate, two to one, after a vigorous debate, which if continued longer, might have made the defeat well-nigh unanimous. American public opinion of to-day apparently approves as strongly as ever the reserving of our huge domestic commerce to carriers launched from American shipyards, as a sure expedient to maintain the shipbuilding art in America, so that there may always be machinery and men for the construction and upkeep of our warships.

The first departure from the national policy of granting the American flag only to American-built ships was taken in an unexpected amendment to the Panama Canal Act of August 24th, 1912. Shipbuilding for the foreign trade had ceased in the United States, except for the few subsidized mail lines. It was argued, and accepted, that our shipyards would not be hurt by an offer of American registry to foreign-built American-owned ships for foreign commerce. But this new departure, to the surprise of its political friends, but not to the surprise of experienced shipowners and merchants, proved absolutely futile. Not one foreign-built

ship of any kind received or applied for the American flag. The cost of operation was the obvious explanation. It would have been increased in the case of any ship brought beneath American laws, and naturalization would have involved the instant loss of foreign subsidies wherever these were granted.

Thus the situation stood at the outbreak of the great war in Europe. That war created a new and powerful motive for the possession of an American fleet in ocean trade, for Great Britain and Germany were our chief ocean carriers, and for a time our export and import commerce was gravely disorganized. The war also created a new motive for the bringing under the American flag of a great part of the shipping—estimated at 1,000,000 tons—in which American capital was interested on the registry of foreign governments. The United States, as the one great and powerful neutral, was in a position to give the most secure protection to its own merchant ships—an advantage vividly reflected in preferential rates of war insurance, which in many trades for the time being more than offset any enhanced cost of American operation.

A new free registry law, approved August 18th, 1914, broadened the free ship section of the Panama Canal Act by admitting foreign-built vessels for use in the foreign trade, without distinction of age. The Panama Act had a restriction that ships should be "not more than five years old at the time they apply for registry." Moreover, because shipowners desired to retain faithful foreign officers long in their employ, and there was some question whether enough Americans would be available, the President was authorized in the new act to suspend the requirement that the master and all deck and engineer officers in charge of a watch should be American citizens. As an additional inducement, the President was authorized also to exempt foreign-built vessels from compliance with American measurement and inspection laws.

This somewhat extraordinary legislation, which actually gives foreign-built vessels an important preference over American-built vessels in the overseas trade of the United States, has, together with the war itself, brought under the American flag at this writing 36 foreign-built vessels of 135,895 gross tons—a valuable reinforcement to the 1,027,776 tons of American shipping already registered for foreign commerce, but a result that falls far short of any adequate and enduring solution of the problem of a great American marine. With a very few exceptions the ships thus naturalized were American-owned before the war began. There has been no sign of any substantial American purchase of foreign-built ships now controlled by subjects or citizens of foreign governments—a fact which, perhaps, is not surprising in view of the declaration of London and of the emphatic protests of the British, French, and Russian ambassadors that the transfer of idle German ships to the American flag would be held invalid, and that the craft would be seized as lawful prizes of war.

Another indication that the new free registry law, standing by itself, will prove of only partial and fleeting benefit is that the foreign officers of some of these naturalized vessels have promptly claimed and received the wage rate of American officers. On one steamer of the United States Steel Corporation this has increased the cost of the British engine room force from \$282 a month to \$420. A similar advance in the pay of the master and deck officers is apparently inevitable. Except on the few subsidized mail liners, there is now no requirement that the crews of American merchant ships below the watch officers in rank shall be American citizens. An entirely foreign complement of sailors, firemen, etc., can be employed. And yet the wage scale of American ships in American ports is from 30 to 50 per cent higher than the wage scale of ships of foreign register. Wages on shipboard are determined, not by the "antiquated" navigation laws, much berated and little understood, but by natural economic law, not to be repealed or changed by act of Congress—by the general rate of wages and standards of living prevalent on shore in the United States—exactly as shipboard wages are determined everywhere else in the whole world.

That the free registry law for this and other causes will fail of full and permanent effect is seemingly recognized by its chief authors and champions, for President Wilson and some of his party leaders have been pressing another bill for the Government control and operation of steamship companies in which private investors shall be allowed to have a minority interest. This is plainly regarded as a very doubtful expedient by the informed maritime opinion of America, which

has quite unitedly protested against it as certain to discourage private initiative, and to delay indefinitely the creation of a real merchant fleet.

To the present trial of a free registry law for the foreign trade there can be no objection. It is already the law of the land, and the actual value of a free ship policy can now be tested under favoring conditions at a time when no more positive legislation can be secured from Congress. To the free registry law there should immediately be added a frank and searching examination of the navigation laws, and no new laws or regulations that may cramp American shipowners should be enacted at the present time. American methods—not laws—of measurement can be improved. Some American inspection rules, not enforced elsewhere, are unnecessarily rigid. There is no reason why American ships should be compelled to have more officers and men than foreign ships. It was exactly the contrary when the Stars and Stripes flew everywhere victorious. An investigation, modernizing and liberalizing the whole system of navigation enactments should certainly be had at once by the best board or commission of expert authority that can be summoned from the entire nation.

But this also, like the free registry law, will not alone suffice. The British merchant shipping acts, the result of the largest and most successful maritime experience, may be adopted word for word by the American Congress, and yet the heart of this question of American shipping will not be reached.

The real heart of the problem lies in these three facts: (1) that the ocean shipping business of the world, including nine tenths of our own import and export business, is now monopolized by the shipowners of foreign governments, who are determined to retain it, in order to keep their own commerce as great and our commerce as small as possible—controlling our own delivery wagons they know that they can do it; (2) that nearly fifty million dollars in subsidies and bounties of various kinds are annually bestowed upon their ocean shipping by Europe and Japan—and where no subsidies are paid other and equally effective national aid and encouragement are given; and (3) that, as in our land industries, protected by the tariff or natural conditions, American wages and standards of living are the highest in the world, so they have been, and are in all probability will remain upon the seas.

American capital, even with free ships and equalized navigation laws, will not go into and remain in ocean shipowning under the American flag unless it can earn dividends at least equal to those now earned under foreign colors. The maritime condition now confronting the American people is strikingly like that which faced Washington, Jefferson, and Madison in 1789. They met it, with vigor, courage, and patriotism, in a series of enactments that gave preference in employment to American ships, in the carrying of American commerce. Either this must be done again, as was actually proposed, but nullified and abandoned in the new tariff law of the present administration, or a comprehensive system of subsidies or subventions will have to be adopted, or some other but equivalent form of national aid and encouragement will have to be discovered and applied.

Neither the war itself, nor the free registry act nor an overhauling of the navigation laws will give the American people the ocean fleet which is their dream and birthright. There must be new, strong, positive legislation, framed, enacted, and enforced by men who are as ready, when they believe they are right, to hoist the flag and go ahead as were the fathers of the republic.

Compressed Carbon Dioxide for Small Arms

AIR guns are awkward to load and have but little penetrating power. If it were not for this they would probably have found somewhat extensive application for sporting purposes. There has been recently placed upon the market a gun in which compressed carbon dioxide is used as the propelling agent. The carbon dioxide, according to a note in *Prometheus*, is contained in a small interchangeable case, holding sufficient for from 100 to 800 shots, and lodged in the gun. Upon pulling the trigger the requisite amount of the gas is admitted into the cup and propels the shot from the barrel. With small shot the gun has a range of about 80 feet; with bullets a range of about 130 feet. The number of shots which can be fired depends, of course, on the bore of the gun. About 100 shots can be fired with small shot, 150 with a bullet of number 8, 300 with a bullet size 6, and 800 with a bullet size 4.

The Electric High School

(Concluded from page 320.)

The gymnasium is equipped with various sizes of apparatus so that all children from the chief grade building across the street from the high school may have the use of the gymnasium in their turn.

It might seem that the use of electricity for heating a building of this size might be a complicated and intricate affair, but this is not the case, and one wonders that the world has waited so long to make this use of electricity, which is feasible in any part of the country where cheap hydro-electric power is available, and especially if it could be used in competition with high-priced coal as is the case at Rupert.

Use is made of the usual system of hot air flues, pipes, plenum chamber and ventilating fan, but the steam coils or coal furnace usually employed for heating the air to be driven into the various rooms is replaced by a battery of electric heating elements similar to those used in electric baking ovens. This heating equipment is installed below the front entrance to the building and consists of twenty-two 18-kilowatt units connected up in pairs, each pair with separate switch control from the switchboard in the principal's office. The transformer room adjoins the furnace room, and is of absolutely fireproof construction ventilated by outside windows with steel casings and frames. The transformer is fed from the 4,000-volt, four-wire distributing system of the Rupert Electric Company by underground cable. It is a 400-kilowatt capacity, three-phase, self-cooling type filled with oil. Low-tension leads are brought out for full capacity at either 440 or 220 volts. An emergency switch in the principal's office may be used to open the 4,000-volt circuit and cut the power entirely out of the building. The switchboard in this office, with its eleven switches, anyone of which may be used to throw its unit on either 440 or 220 volts, and thus use either 9 or 36 kilowatts, gives opportunity to use any amount of current from nothing to about 400 kilowatts in steps of 9 or any multiple thereof. While dampers are provided in the pipes leading to each room, the amount of air provided for each room has been so accurately determined that it is seldom necessary to use them, the temperature throughout the building being practically uniform and under the control of the switchboard. The fresh air is drawn down the cold air shafts from the top of the front entrance, heated by being drawn through the electrically heated units, and forced into the plenum chamber where it is moistened and forced out to the various rooms through the usual pipes and flues. The heated air enters the rooms near the top and the foul air is removed from each room through brick flues to the roof of the building.

The building has a cubical content of 300,000 cubic feet. The fan supplies 20,000 cubic feet per minute and can, therefore, replace all the air in the building in fifteen minutes. At night the building is kept warm without the fan by switching the heaters to low voltage, cutting off the supply of cold air, and opening the doors of the rooms into the corridors. In the morning the fan is started to equalize the temperature, and when up to 70 degrees the fresh air damper is again opened.

The system was put to work in January, with a new, incomplete, and thoroughly cold building, with bitterly cold and windy weather, and yet proved that it could heat and ventilate the building with less than two thirds of the maximum capacity of the plant. Current for heating purposes is furnished at a flat rate of \$1 per kilowatt per month, maximum amount used during the winter months to be paid for at least four months, making a minimum charge of \$4 per kilowatt for the season. On this basis it was figured that the use of current for heating purposes would cost \$1,760 per year, but experiment proves that this may be cut to \$1,500 or less. Coal alone would have cost \$1,000 per year, and would have required the services of a fireman, whose wages are saved by the use of electricity. As the cost of installation was less than

of any other system of heat it will be seen that the use of electricity is proven to be an actual economy in the Rupert building, to say nothing of the saving of space and the saving from the annoyance of smoke, dust, and other disadvantages of any system using coal as a fuel. Under this system the heating of the building for use at night may be accomplished with no extra expense except current used for driving the fan. As the building is to be a community center and used to the fullest extent this is an important matter. The building is electrically lighted throughout, so that any or all rooms may be used at night, the lighting of auditorium, stage, gymnasium, lecture and other science rooms being exceptionally fine. Electricity is used for cooking; for heating water for the cooking rooms, the shower baths, the various lavatories throughout the building, and for the science rooms, for ironing, for power, for evaporation purposes in the science rooms, for distilling water, for the stereopticon in the auditorium and lecture room, for experimental purposes, and if the odors from cooking ever become offensive an electric ozonator will be used to destroy the odors. Current for all these purposes are on a graduated metered basis and vary with the use to which the current is put.

Radio-telegraphy at the Eiffel Tower

(Concluded from page 321.)

In itself makes this station one of great importance. As is to be expected in an experimental plant, several distinct transmitters and a variety of receiving instruments are installed. The largest transmitter is one of 1,000 cycles, 150 kilowatts power, which has only recently been put in place, and which operates according to the plan developed by Bethenod and the Société Française Radio-electrique for developing a single frequency of radiation. By such purity of emission, in combination with the high musical spark tone given by the 1,000 cycle alternator, it is possible to take advantage of sharp tuning for selection of desired messages, and, by the ear alone, to distinguish the singing spark signals through the rumbling noises of atmospheric disturbances which would prevent reception from a lower-toned spark transmitter. The spark frequency can be made as high as 2,000 per second, but is usually about one third this, so as to allow the sending condensers to charge at a higher pressure by making use of resonance in the power circuits. Fig. 1 shows the motor, generator, and controlling switchboard for the large outfit, and Fig. 2 gives a view of the operating keys which are used for making the dots and dashes of Morse signals on the various transmitters. In this photograph there can also be seen portions of the switchboards and auxiliary apparatus which are used to make the adjustments necessary in sending.

The old high power transmitter is one of from 60 to 80 kilowatts power, which draws its 220-volt energy from the public mains at 42 cycles. By variable iron-core coils the power circuit is made resonant, and the spark is ordinarily allowed to pass at only each third alternation, or about twenty-eight times per second. In marked contrast to the 1,000-cycle sender, this outfit does not emit signals in musical tones, but in a sort of rattling sound which it has been found almost impossible to interpret when the similar noises from atmospheric electrical discharges are at all loud.

A tremendous battery of glass jar condensers is used with the low-frequency transmitter, giving a total effective capacity quoted as about seven tenths of one microfarad. The spark takes place between the end of a brass tube (through which the air is forced by a blower) and a flat copper plate, as shown in Fig. 4, a type of spark gap which has shown extended use in France. The large condenser makes necessary special provisions for handling high values of high-frequency current, and so the inductance coil of the large transmitter is bent from copper tubing about ten centimeters (nearly four inches) in diameter. Likewise, the large



Fair Play in Telephone Rates

IT is human nature to resent paying more than anyone else and to demand cheap telephone service regardless of the cost of providing it.

But service at a uniform rate wouldn't be cheap.

It would simply mean that those making a few calls a day were paying for the service of the merchant or corporation handling hundreds of calls.

That wouldn't be fair, would it? No more so than that you should pay the same charge for a quart of milk as another pays for a gallon.

To be of the greatest usefulness, the telephone should reach every home, office and business place. To put it there, rates must be so graded that every person may have the kind of service he requires, at a rate he can easily afford.

Abroad, uniform rates have

been tried by the government-owned systems and have so restricted the use of the telephone that it is of small value.

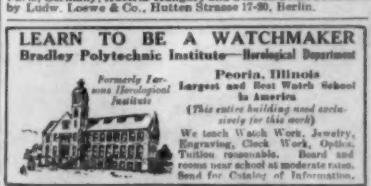
The great majority of Bell subscribers actually pay less than the average rate. There are a few who use the telephone in their business for their profit who pay according to their use, establishing an average rate higher than that paid by the majority of the subscribers.

To make a uniform rate would be increasing the price to the many for the benefit of the few.

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condenser forces the station to operate on long wave-lengths, and even then to use little self-inductance in the circuits; for a 2,150-meter wave-length less than two turns of coil are placed in the condenser circuit.

The Eiffel station has also been equipped with a 10-kilowatt 42-cycle transmitter, for signaling moderately short distances, and a 22-kilowatt 1,000-cycle set. It is this last named outfit which is shown partially by Fig. 4. A rotary gap has also been provided, and is shown in Fig. 3. This gap may be substituted for one of the tube-and-plate gaps, but is not an interrupter (such as often is used in American stations), since the sparking distance remains constant as the rotating electrode spins. The only function of the motion is to keep the gap cool by spreading successive sparks out over different parts of the stationary electrode. This cooling is effected, in the tube-and-plate gaps, by the air blast from the blower shown in Fig. 5. The power transformer (at the left), condenser tubes stacked in racks, and the inductance coil of the 60-0 kilowatt set can also be seen in this photograph.

The Paris station has become widely known through the long-distance tests which it has made. Communication with Algeria and Tunis is understood to be regular, and within the past few months there was completed a series of important experiments in time and longitude differences between the Eiffel station and the United States naval high-powered plant at Arlington, Va., 3,700 miles away. The Eiffel station was selected by the recent International Conference at Paris as the center of a group of powerful equipments for an international time service, and now sends exactly regulated signals at 10 in the morning and at midnight each day. These serve to fix Greenwich time to the fraction of a second for any listening wireless station within range, and thus make it possible for the masters of ships at sea to secure standard time for making astronomical observations of their positions. Meteorological telegrams are sent broadcast at fixed hours each day, and the advance weather reports and storm warnings prove of value not only to those at sea, but to the farmers who have arranged for their reception at convenient points inland. In this way the Eiffel tower station is proving of immediate use to the people of France and the surrounding countries, while, in addition, the importance of its potential value in case of war, and the excellent work it is doing toward ultimate opening of the world-embracing radio-telegraph chain, are held in the highest esteem.

Strategic Moves of the War

(Concluded from page 322.)

their right flank extended 100 miles to the southwest and threatened Ossowetz, where the railroad southeast from Lyck crosses the Narew River. Their plan was to push this southern move so as to get in behind the Russian army at Warsaw. Then the advance of the German army from western Poland was to cause a combined pressure on the Russians that would force them to let up in their attacks on the Austrians in order to save their own army to the north.

To offset this move the Russians concentrated forces at Grodno and moved northwest against the center of the East Prussian army. The mud hampered the movements of both armies, but the Russians, being better equipped for getting artillery and wagons over soft roads, were able to make better use of their troops, and especially were able to move their artillery to vantage points. The tactics of frontal attacks are almost entirely dependent on the protection of artillery fire. So great is the supply of ammunition furnished that the most inaccurate marksmen could drive back an attack of unsupported infantry. The rapid-firing field guns, by sprinkling the advancing columns with a hail of shrapnel, can by their own fire alone stop the charge of any uncontrolled troops.

The German artillery is mostly built for service where the ground is hard

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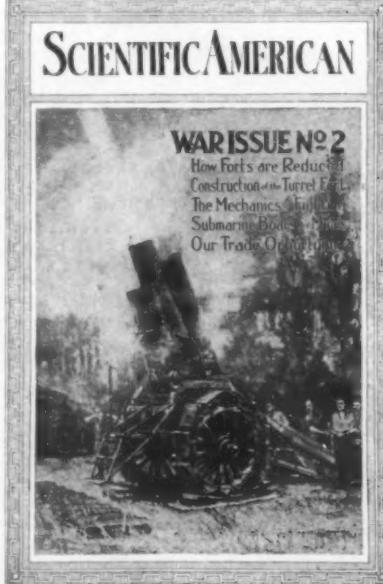
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enough to permit driving across in any direction. The low set wheel reduces the leverage for progress through deep mud. The automobile trucks on which the army depends for its supply service are still less suited for traversing soft roads and fields. The Russian field guns, like those of the United States, are higher set, due to their development through service in districts where good roads are few and far between. Consequently, the prolonged rainy weather of the last two weeks in this battle zone has fought on the side of the Russians. They have been able to get their artillery up into action, while that of the Germans has been to some extent stuck in the mud.

This local fire superiority enabled the Russians to bring a shrapnel fire to bear on the German line that forced the defenders to stay under cover. In many places the saturated soil forbade the construction of the splinter proofs, or roofed-over pits, necessary for protection against the fall of the shrapnel bullets. So when the Russian artillery secured the dominance, the Germans had no choice but to retire.

It is these tactics that enabled the Russians to break through the center of the German line at Augustow on October 1st. The retreat of the center endangered the flanks so that they too had to fall back. The Russian success has been further pursued until the Germans have been forced back to a line through Lyck, 10 miles west of the border.

This strategic gain of the Russians relieves pressure on their central army in Poland and allows them to proceed with the pushing forward of troops through this district to attack the Germans in western Poland. In order to permit their central army to become fully organized before coming into contact with the Germans, the Russians had to concentrate their forces east of Warsaw. An attempt to protect the Polish border would have exposed the first Russian forces in the field to being overwhelmed and captured by the larger armies that Germany could at first move to the front, due to her better rail facilities.

In Galicia the stiffening of the Austrian line along the Donajec River, 50 miles east of Cracow, has held back the Russians for a week. The further advance of the general Russian line in the campaign against Germany depends upon clearing one of the flanks. It is for this reason that Russia is concentrating her efforts on the two flanks. As soon as one of them gives away, they will be free to push forward without exposing their lines to an attack from both flanks.

The invasion of Hungary by Cossack divisions is in line with Russia's general conduct of campaigns, but is not an immediate part of the general campaign in Poland and Silesia. Just as Gourko's cavalry was rushed forward to the Balkan passes in the war of 1878 against Turkey, to prevent Turkish reinforcement of the garrison of Pleyna, so are the Cossacks now being poured into Hungary to divert Austrian troops from the Galician field. This invasion gives Russia a chance to make use of her large numbers of mounted troops that cannot be used to best advantage in the main battles. It also throws the burden of the war upon additional provinces of her enemy.

Electric Power as a By-product at Mines

At a mine in South Africa, says *Prometheus*, the water supply has to be drawn from a considerable distance, and must, on its way, cross a ridge some 600-feet high. The water arriving at the mine is thus under considerable head, and power is recovered from it by means of Pelton wheels driving dynamos. In this way from 90 to 100 horse-power is gained, according to the volume of water flowing, and is utilized for various purposes at the mine. At another mine the cars conveying the ore run down an incline a vertical distance of about 250 feet. From the 2,200 tons of ore daily mined some 50 horse-power of electrical energy are here recovered by winding the cable of each car around a drum which actuates a dynamo.

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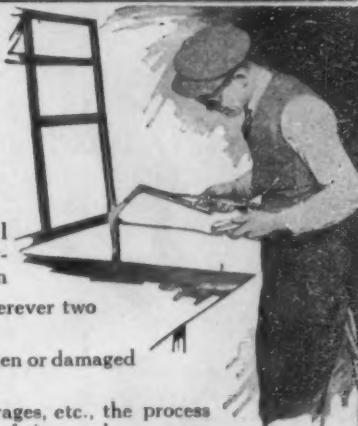
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In commemoration of that historic twenty-first day of October, 1879, in recognition of the vast benefits that your great invention has conferred on mankind, and in admiration of the genius that created not only the incandescent lamp but the present lighting industry, this appreciation is published by the Edison Lamp Works of the General Electric Company.



"The first time I met Edison was in 1893, at the International Electrical Congress at Chicago. Mr. Rudolf Eickemeyer introduced me to him, and Edison, jokingly pointing at me, said "pure theory," pointing at Eickemeyer, "theory and practice" and at himself, "pure practice." This is the attitude Edison has always taken, declaring himself a mere practical man, and the newspaper men have expanded on this and so created the popular belief that Edison does not know anything about theory and science, but merely experiments and tries anything he or anybody else can think of. There is nothing more untrue than this. It is true Edison never went to any college—but he knows more about the subjects taught in colleges than most college men. From my experience I consider Edison today as the man best informed in all fields of human knowledge."

CHARLES P. STEINMETZ



"His work, and particularly the invention of the electric incandescent lamp, must forever remain an inspiration to mankind. The long weeks and months of tedious experimenting, the dauntless patience that bravely struggled on after each momentary defeat, and the resourcefulness that turned even failure to account have perhaps never been equalled and certainly never surpassed in the history of human achievement."

No wonder that this man enriched his time with one of its most precious inventions—the Edison lamp—with a form of illumination so wonderfully cheap and efficient that it has enabled the teacher and the printer to extend the influence of civilisation where it has never been felt before."

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